GEOTECHNICAL ENGINEERING REPORT
Four Mile Run Trail
Arlington, Virginia

Prepared for:

Kittelson & Associates, Inc.
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Prepared by:

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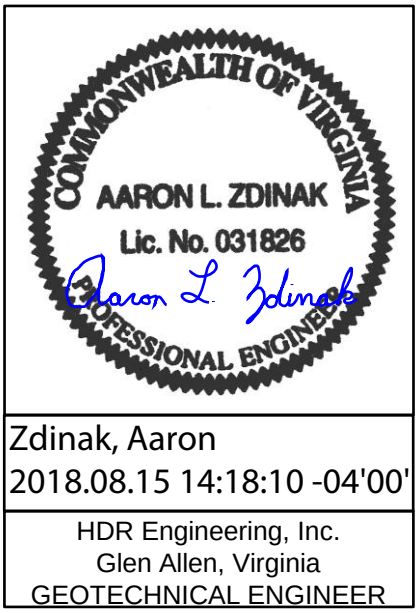
August 15, 2018



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APPENDICES

1.0 AUTHORIZATION

HDR Engineering, Inc. (HDR) is pleased to submit this Geotechnical Engineering Report (GER) for the 4 Mile Run-Trail in Arlington, Virginia. The services were completed in accordance with Task Order #20 issued by Kittelson & Associates on May 11, 2016 pursuant to the provisions of the September 26, 2012 Subconsultant Agreement. During project development, the planned trail layout eliminated the need for retaining structure design, and HDR's Task Order #20 was modified by Amendment #1 dated January 31, 2017 to eliminate structural design efforts.

On March 28, 2017, Amendment #2 authorized HDR to complete a review of existing environmental documentation relevant to the project site to determine impacts to development resulting from potential contamination; a condition identified after the issuance of Task Order #20. HDR has completed its work in accordance with the amended Task Order #20.

2.0 SITE DESCRIPTION

The project site is located near the southeastern boarder of Arlington County, Virginia, within the city of Arlington. The site is a graded slope with grass cover that grades from approximately El. 27 feet on the northern edge to about El. 5 feet on the southern edge. Currently a concrete sidewalk runs along the western edge of the project and connects to a concrete trail that runs along the Four Mile Run stream to the south of the project. Between South 39th Street and the project is a recently constructed playground with sidewalks, creating the northern edge of the project site. Figure 1 in Appendix A provides a site location map.

3.0 PROJECT DESCRIPTION

The purpose of this project is to create a new asphalt pedestrian trail that will connect the trail in the northwestern corner of the site to the trail along the stream. The tie in location along the stream will occur in the southeastern corner of the site. In order to construct the new trail, regrading of the site will be required and will involve cuts up to 13 feet and fills up to 3 feet. Portions of existing concrete sidewalks in the northwestern and southeastern will be demolished and reconstructed to properly tie in the new asphalt trail. Figure 2 of Appendix A depicts the proposed site grading and layout of the trails.

4.0 OBJECTIVE AND SCOPE

The objective of our geotechnical subsurface exploration program is to characterize subsurface conditions in the area of the proposed Trail and the associated grading to support geotechnical design. To achieve this objective, HDR executed the following scope of services:

- Conducted a subsurface exploration program to evaluate subsurface conditions within the area of the proposed Trail and the associated grading
- Completed geotechnical laboratory testing on selected soil samples
- Prepared this GER summarizing the results of the exploration program and geotechnical design recommendations for the proposed trail pavement, grading, and general earthwork

- Provided support to the design team during development of contract drawings and specifications.

In addition to the primary objective, HDR used the subsurface exploration program to screen for the potential of environmentally impacted soils within the depths of disturbance on the site. To achieve this objective, HDR executed the following scope of services:

- Collected environmental samples in concurrence with the geotechnical subsurface exploration in order to identify contaminants
- Completed environmental laboratory testing on selected soil samples
- Summarized the results of the environmental laboratory testing and provided recommendations for the reuse or disposal of observed, potentially impacted soils (Appendix E).

The following services were not provided by HDR as part of our study: post-exploration subsurface water observations, surveying of proposed or as-drilled exploration locations, an environmental site assessment, preparation of plans and specifications, and construction cost or quantity estimates.

5.0 SUBSURFACE EXPLORATION

HDR planned and executed a subsurface exploration program to collect subsurface data at the exploration locations shown on Figure 2 in Appendix A. Soil and Land Use Technology (SaLUT) of Glen Burnie, Maryland drilled the test borings on August 21, 2017 using an Acker Scout rubber track drill rig and a Mobile B-57 rubber tire drill rig.

Four test borings (17BH-01, -02, -03, and -04) were drilled to depths ranging from 10.0 to 20.0 feet below ground surface to collect data in order to evaluate the stability of the slope and assess for the potential presence of environmentally impacted soils.

Test borings were advanced using 3.25 inch inner-diameter hollow stem augers. Standard Penetration Tests (SPT) with split-barrel spoon sampling of soils were conducted in accordance with ASTM D1556 using an automatic hammer with the Mobile rig and a safety hammer with the Acker Scout rig. Continuous 24-inch long SPT samples were collected for the full depth of the boring. When necessary, the samples collected were divided to provide enough material to complete geotechnical and environmental laboratory testing. Split spoons were decontaminated between each split spoon interval, and augers were decontaminated between each test boring. The borings were backfilled with grout upon completion. Remaining spoils were placed in 50-gallon sealed drums and left on site within a fenced area. After drilling, the geotechnical exploration soil samples were transported to SaLUT's laboratory in Glen Burnie, Maryland, for testing, and the environmental exploration samples were shipped to Air, Water, and Soil Laboratories Inc. in Richmond, VA.

HDR personnel monitored the drilling in the field and prepared field logs of the test borings. Monitoring included overall coordination of drilling activities, visual-manual classification of disturbed soil samples, preparation of field exploration logs, proper collection of environmental samples, monitoring conformance with sampling criteria established for each exploration, and observation of general site conditions.

Pocket penetrometer tests were performed on cohesive soil samples at the time of sample collection. The results of the pocket penetrometer tests are shown on the exploration logs provided in Appendix B.

HDR personnel laid out the planned exploration locations in the field based on ALTA's proposed grading site plan, shown in Appendix A Figure 2, by measuring from existing site features. Approximate as-drilled exploration locations were not instrument-surveyed. Approximate surface elevations at the exploration locations, which can be seen on the exploration logs, were also collected from ALTA's proposed grading site plan and are referenced to the North American Vertical Datum (NAVD) 88.

6.0 SUBSURFACE SUMMARY

The following sections summarize our review of available geologic data and the results of subsurface explorations completed at the project site. Specific observations, remarks, and comments are noted on the exploration logs provided in Appendix B.

6.1 Area Geology

The project site is located in the Coastal Plain Physiographic Province of Virginia. The Coastal Plain is characterized by poorly to well-sorted unconsolidated marine to fluvial sediments, varying from clay to gravel with lateral variation in thickness. These sediments generally increase in thickness towards the east. Vertical variation within the geologic formations of the Coastal Plain is often controlled by cyclic transgression and regression depositional sequences that coarsen with depth.

Regionally, the stratigraphy of the Coastal Plain can be generalized as a wedge of sediments composed of fluvial and coastal plain sands and gravels of Quaternary and upper Tertiary age, underlain by marine, deltaic, and fluvial clays, silts, and sands of lower Tertiary age, underlain by fluvial-deltaic to shallow-shelf sands and clays of Cretaceous age, underlain by crystalline bedrock.

Locally, the project site is characterized by artificial fills overlying Holocene (alluvium soils). Soils generally consist of unconsolidated sand, silt, and gravel and clay fluvial deposits underlying modern floodplains and marshes.

6.2 Subsurface Conditions

Four boring explorations (designated as 17BH-01, -02, -03, and -04) were completed to depths ranging from 10.0 to 20.0 feet below the ground surface. SPT N-values ranged from WOH to split spoon refusal (50/3"). Table 1 provides a summary of the explorations including surface elevations, boring depths, topsoil thickness, and observed groundwater depths and approximate elevations. Rock was not encountered during exploration.

Table 1 – Summary of Explorations

Test Boring	Approximate Station[1]	Surface El. Test Boring (ft)[1]	Test Boring Depth (ft)	Top Soil Thickness (ft)	Subsurface water At Time of Drilling	
					Depth (ft)	El. (ft)[1]
17BH-01	10+75	26.5	18.0	0.4	8.0	18.5
17BH-02	11+25	11	10.0	0.4	5.0	6.0
17BH-03	12+00	25.5	20.0	0.4	12.0	13.5
17BH-04	12+50	18	12.0	0.5	NE[2]	NE[2]

[1]Boring locations and surface elevations are approximate only. Stations and elevations are based on field measurements from existing site features and Figure 2 in Appendix A.
[2]Subsurface water was Not Encountered.

In general, the following subsurface strata were observed in the test borings:

- **Topsoil** – Topsoil was encountered in all test borings to depths of approximately 0.4-0.5 feet.
- **Fill** – Fill was encountered in all explorations to depths of approximately 4 to 10 feet. Fill generally consisted of stiff cohesive soils (CL) and very loose to very dense granular soils (SP, SC, SM, SP-SC).
- **Alluvium** – Alluvial soils were encountered in all test borings below the fill, where present, to depths corresponding to boring termination. Alluvial soils consisted of very soft to very stiff cohesive soils (CL and CL-ML) and loose to medium dense granular soils (SC).

6.3 Subsurface Water

Subsurface water levels were recorded at the time of drilling in test borings 17BH-01, -02, and -03. These groundwater levels are provided in Table 1. Subsurface water was not encountered during drilling in test boring 17BH-04. All borings were drilled adjacent to the Four Mile Run stream. The subsurface water levels may be influenced by the surface water.

Borings were backfilled with grout upon completion for safety reasons, which prevented post exploration subsurface water level measurements. Subsurface water levels tend to fluctuate due to precipitation, season, temperature, site grading, and other factors that may be different from those prevailing at the time HDR completed its subsurface explorations.

7.0 LABORATORY TESTING

The following sections summarize the laboratory testing was assigned by HDR on select soil samples. Both geotechnical and environmental laboratory testing was completed.

7.1 Geotechnical

Geotechnical laboratory testing services were performed by SaLUT in Glen Burnie, Maryland. HDR personnel evaluated the field exploration logs and assigned specific samples for testing. Testing was performed to aid in the classification of soils encountered in the explorations and to support development of geotechnical engineering parameters to support design efforts. The following laboratory testing was completed on soil samples as part of this evaluation: 16 Natural Moisture Content determinations, seven Atterberg Limits determinations, seven % Passing No. 200 Sieve tests, and two Hydrometer grain size distribution tests.

The geotechnical laboratory tests were performed in accordance with applicable ASTM and VTM test methods. The results of the laboratory tests are presented in Appendix C.

7.2 Environmental

Environment laboratory testing services were performed by Air, Water and Soil Laboratories Inc., in Richmond, VA. Environmental testing was performed to determine the presence and quantity of potential contamination at the site. The following laboratory testing was completed on select soil samples:

- Volatile Organic Compounds (VOC's) - Solids (SW8260B)
- TAL Metals – Solids (SW6010C)
- Semi-Volatile Organic Compounds (SVOC's) - Solids (SW8270D)
- Percent Solids (SM18 2540G)
- PCB's – Solids (SW8082A)

The results of the environmental laboratory tests are presented in Appendix E.

8.0 ANALYSIS AND DISCUSSION

The following sections describe our geotechnical analyses used to develop recommendations for the proposed trail pavement, grading, and general earthwork for the Four Mile Run Trail. Specific geotechnical design parameters used in our analyses are provided in summary tables within the calculations. Geotechnical design recommendations are provided in Section 9.0 of this report.

8.1 Global Stability

HDR evaluated global stability of the graded hillside using the computer program Slope-W (Geostudio Suite Version 8.16) and the slope geometry shown on the cross sections, provided by ALTA. Analyses were completed for standard 3H:1V cut and fill slopes, as well as a steepened rip-rap slope.

The slope geometry for the cut and fill slope analysis was based on the deemed critical slope occurring at approximate station 11+50, as depicted in Figure 4 (Appendix A). HDR analyzed both the upper cut slope as well as the lower fill slope, both of which are proposed to be graded at 3H:1V. In developing the soil parameters, HDR used a composite stratigraphy from all site borings to develop a representative condition for the analyses.

The slope geometry for the rip rap slop analysis was based on the deemed critical slope occurring at approximate station 21+50, also depicted in Figure 4 (Appendix A). The slope is proposed to be graded at 1.5H1V, and shall utilize rip-rap to stabilize the slope. In developing the soil parameters at this location, HDR used boring 17BH-04.

The global stability models were analyzed perpendicular through the slope for short-term, undrained conditions and long-term, drained conditions. HDR targeted a 1.5 as the minimum required factor of safety for the long-term mode and a 1.3 for the short-term mode analyses. All conditions analyzed met or exceeded the target minimum factor of safety requirement, with the long-term condition

controlling. The results of our global stability analyses are summarized in Table 2. Calculations are provided in Appendix D.

Table 2 – Summary of Global Stability Analyses

Location		Short-term Factor of Safety[1]		Long-term Factor of Safety[1]	
		Minimum target	Calculated	Minimum target	Calculated
Station 11+50	Upper Cut Slope (3H:1V)	1.3	>2.0	1.5	1.6
	Lower Fill Slope (3H:1V)	1.3	>2.0	1.5	1.6
Station 21+50	Rip Rap Slope (1.5H:1V)	1.3	1.8	1.5	1.5
[1] Minimum required factor-of-safety is specified in AASHTO (2016).					

8.2 Pedestrian Trail Pavement

We understand traffic loads for the planned pedestrian trail pavement are very low and likely consist of an occasional pickup truck on the trail in addition to the planned pedestrian traffic. HDR calculated a structural number (SN) of 1.6 assuming a minimum pavement section consisting of 2 inches of asphalt (surface) underlain by 6 inches of compacted aggregate subbase. HDR calculates a SN of 1.6 is adequate to support the design level traffic with subgrades characterized modestly with a California Bearing Ratio (CBR) of 3.0. Calculations for the trail pavement section are in Appendix D.

HDR understands that the concrete pedestrian trail pavement will match the existing concrete slab section of 4 inches of concrete underlain by 6 inches of compacted aggregate subbase. The proposed concrete section has a greater traffic carrying capacity than the asphalt concrete section and is also judged adequate to carry the anticipate traffic loading.

9.0 GEOTECHNICAL RECOMMENDATIONS

Recommendations for the proposed trail pavement, grading, and general earthwork are provided in the following sections.

9.1 Slope Design

HDR recommends that all unstabilized slopes be graded no steeper than 3H:1V to maintain stability, allow the establishment of vegetative growth, and to permit maintenance activities in the future by County staff. We note that part of the grading plan also relies on steepened slopes (1.5H:1V). HDR recommends that slopes up to approximately six feet in height (as currently planned) be constructed to include a minimum thickness of rip-rap of three feet armoring all slope surfaces. Additionally, all slope stabilizing rip-rap should be embedded a minimum of two feet at the toe of the slope to maintain an appropriate degree of stability.

9.2 Pedestrian Trail Pavement Design

HDR recommends asphalt pedestrian trail pavement be comprised of:

- Surface Course: 1” SM-9.0A
- Intermediate Course: 3” IM-19.0A
- Subbase Course: 6” VDOT No. 21B Dense Graded Aggregate

We recommend concrete pedestrian trail pavement be comprised of:

- Surface Course: 4" Concrete
- Subbase Course: 4" VDOT No. 21B Dense Graded Aggregate

9.3 Unsuitable Materials

Unsuitable materials with respect to embankment fill and cut area subgrades are defined as any soils with one or more of the following properties:

- Classifies as CH, MH, OH and OL in accordance with the Unified Soil Classification System (USCS),
- Contains more than 5% by weight organic matter,
- A design California Bearing Ratio (CBR) value less than 3 and/or a swell greater than 5% as determined from CBR testing in accordance with VTM-8.

Soils that are otherwise suitable, but are in a condition that is $\pm$ 3% of optimum moisture content (i.e. saturated or very dry) and/or very loose or very soft coarse/fine grained soils that exhibit excessive pumping, weaving or rutting under the weight of construction equipment are also considered unsuitable unless they can be moisture conditioned to an acceptable moisture content range that allows adequate compaction to meet project specifications.

As a result of the encountered conditions and the proposed grading, HDR anticipates unsuitable subgrade soils will exist within the cut portions of Greenway B pavement areas (Greenway A and C tend to be founded near existing grade or on fill) and should be over-excavated to a depth of one-foot below planned subgrade and backfilled with suitable soils per Section 9.4 of this report. HDR recommends all overexcavated subgrades be covered with a geotextile for use in stabilization per section 245.03(d) of the 2016 VDOT Road and Bridge Specification. Outside of the Greenway B pavement areas, additional areas of unsuitable subgrade soils could be encountered and would also required undercut on a limited basis due to unforeseen conditions that may only become evident during construction.

9.4 Considerations for Earthwork

Onsite excavated soils may be considered for reuse as fill provided they meet the requirements stated in this section and the contract documents. Site grading may be accomplished with fill soils obtained from either onsite operations or offsite borrow, and should classify as SC, SM, SW, SP, GC, GM, GW, GP, CL, or ML.

Potential site grading fill soils should be tested by an accredited AMRL laboratory and shall meet the following requirements or as consistent with City of Arlington standards for embankment construction:

- Liquid Limit: 30% max
- Plasticity Index: 15 max
- Percentage of fines (minus 200 sieve – 0.075 mm): 70% max

In general, most onsite soils are acceptable for reuse as fill, particularly when excavated blended from across the site and blended as a result of typical earthwork activities.

10.0 IMPACT OF ENVIRONMENTAL CONDITIONS

An environmental screening was conducted in conjunction with the geotechnical investigation. Details of the screening are provided in Appendix E. In summary, very few of the analytes tested for exceed the EPA Regional Screening Levels using a Target Cancer Risk (TR) of 1E-06 with a Target Hazard Quotient (THQ) of 1.0 based on the June 2017 presented information. Those of the analytes identified as being above the EPA screening thresholds are summarized in Table 3.

Table 3 –Summary of Analytes Exceeding EPA Regional Screening Level for Resident Soil

Analyte	Referenced Test Method	EPA Regional Screening Resident Soil Threshold (mg/kg)[1]	Lowest Concentration Detected (mg/kg)	Highest Concentration Detected (mg/kg)
Arsenic	EPA SW6010C	0.68	5.99	75.2
Thallium	EPA SW6010C	0.78	<2.5 (DL)	2.88
Benzo (a) pyrene	EPA SW8270D	0.11	<0.0833 (DL)	<0.331 (DL)
Bis (2-chloroethyl) ether	EPA SW8270D	0.23	<0.0833 (DL)	<0.331 (DL)
Dibenzo (a,h) anthracene	EPA SW8270D	0.11	<0.0833 (DL)	<0.331 (DL)
Hexachlorobenzene	EPA SW8270D	0.21	<0.0833 (DL)	<0.331 (DL)
N-Nitroso-di-n-propylamine	EPA SW8270D	0.078	<0.0833 (DL)	<0.331 (DL)

Notes:
[1] Threshold values represent Target Cancer Risk (TR) of 1E-06 with a Target Hazard Quotient (THQ) of 1.0 for purposes of this screening process, June 2017.
DL = Detection Limit as reported by the chemical-analytical laboratory.

Table 4 summarizes the locations where the screening concentrations were exceeded on a per sample basis.

Table 4 – Summary of Samples Exceeding EPA Regional Screening Level for Resident Soil

Analyte	Concentration (mg/kg)	EPA Regional Screening Resident Soil Threshold (mg/kg)[1]	Sample Number	Sample Location, Depth (ft)
Arsenic	41.3	0.68	17H0710-03	17BH-01, 0-4
Arsenic	20.6	0.68	17H0710-04	17BH-01, 4-10
Arsenic	5.99	0.68	17H0710-05	17BH-01, 10-16
Arsenic	9.53	0.68	17H0710-06	17BH-02, 0-6
Arsenic	25.9	0.68	17H0710-01	17BH-03, 0-4
Arsenic	75.2	0.68	17H0710-02	17BH-03, 4-10
Arsenic	17.4	0.68	17H0710-07	17BH-04, 0-4
Arsenic	23.8	0.68	17H0710-08	17BH-04, 4-10
Thallium	<2.5 (DL)	0.78	17H0710-03	17BH-01, 0-4
Thallium	<2.5 (DL)	0.78	17H0710-04	17BH-01, 4-10
Thallium	<2.5 (DL)	0.78	17H0710-05	17BH-01, 10-16
Thallium	<2.5 (DL)	0.78	17H0710-06	17BH-02, 0-6
Thallium	<2.5 (DL)	0.78	17H0710-01	17BH-03, 0-4

Analyte	Concentration (mg/kg)	EPA Regional Screening Resident Soil Threshold (mg/kg)[1]	Sample Number	Sample Location, Depth (ft)
Arsenic	41.3	0.68	17H0710-03	17BH-01, 0-4
Thallium	<2.5 (DL)	0.78	17H0710-02	17BH-03, 4-10
Thallium	2.67	0.78	17H0710-07	17BH-04, 0-4
Thallium	2.88	0.78	17H0710-08	17BH-04, 4-10
Benzo (a) pyrene	<0.322 (DL)	0.11	17H0710-03	17BH-01, 0-4
Benzo (a) pyrene	<0.165 (DL)	0.11	17H0710-04	17BH-01, 4-10
Benzo (a) pyrene	<0.331 (DL)	0.11	17H0710-01	17BH-03, 0-4
Benzo (a) pyrene	<0.325 (DL)	0.11	17H0710-02	17BH-03, 4-10
Benzo (a) pyrene	<0.330 (DL)	0.11	17H0710-07	17BH-04, 0-4
Benzo (a) pyrene	<0.148 (DL)	0.11	17H0710-08	17BH-04, 4-10
Bis (2-chloroethyl) ether	<0.322 (DL)	0.23	17H0710-03	17BH-01, 0-4
Bis (2-chloroethyl) ether	<0.331 (DL)	0.23	17H0710-01	17BH-03, 0-4
Bis (2-chloroethyl) ether	<0.325 (DL)	0.23	17H0710-02	17BH-03, 4-10
Bis (2-chloroethyl) ether	<0.330 (DL)	0.23	17H0710-07	17BH-04, 0-4
Dibenzo (a,h) anthracene	<0.322 (DL)	0.11	17H0710-03	17BH-01, 0-4
Dibenzo (a,h) anthracene	<0.165 (DL)	0.11	17H0710-04	17BH-01, 4-10
Dibenzo (a,h) anthracene	<0.331 (DL)	0.11	17H0710-01	17BH-03, 0-4
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Dibenzo (a,h) anthracene	<0.330 (DL)	0.11	17H0710-07	17BH-04, 0-4
Dibenzo (a,h) anthracene	<0.148 (DL)	0.11	17H0710-08	17BH-04, 4-10
Hexachlorobenzene	<0.322 (DL)	0.21	17H0710-03	17BH-01, 0-4
Hexachlorobenzene	<0.331 (DL)	0.21	17H0710-01	17BH-03, 0-4
Hexachlorobenzene	<0.325 (DL)	0.21	17H0710-02	17BH-03, 4-10
Hexachlorobenzene	<0.330 (DL)	0.21	17H0710-07	17BH-04, 0-4
N-Nitroso-di-n-propylamine	<0.322 (DL)	0.078	17H0710-03	17BH-01, 0-4
N-Nitroso-di-n-propylamine	<0.165 (DL)	0.078	17H0710-04	17BH-01, 4-10
N-Nitroso-di-n-propylamine	<0.0833 (DL)	0.078	17H0710-05	17BH-01, 10-16
N-Nitroso-di-n-propylamine	<0.0833 (DL)	0.078	17H0710-06	17BH-02, 0-6
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N-Nitroso-di-n-propylamine	<0.148 (DL)	0.078	17H0710-08	17BH-04, 4-10

Notes:
[1] Threshold values represent Target Cancer Risk (TR) of 1E-06 with a Target Hazard Quotient (THQ) of 1.0 for purposes of this screening process, June 2017.
DL = Detection Limit as reported by the chemical-analytical laboratory.

Based on the results of this testing, HDR judges that the planned development will not be adversely affected by the presence of the seven analytes listed in Table 3, as detailed in Table 4, and their detected concentrations. Trail areas are paved and the rest of the developed area will be landscaped (topsoil/grass/plantings), which offer separation from the onsite soils.

However, based on the site's history as a former railroad facility, we recommend that chemical-analytical testing be completed during construction to confirm the results of this initial screening.

Additionally, any soils not suitable for reuse onsite which necessitate the need for offsite disposal should be characterized adequately for appropriate disposal at an approved construction site or suitable landfill. Additional discussion of the environmental screening are provided in Appendix E.

11.0 LIMITATIONS

This Geotechnical Engineering Report has been prepared for the exclusive use of Kittelson & Associates Inc. for specific application to the Four Mile Run Trail. This report has been prepared in accordance with generally accepted geotechnical engineering practices. No other warranty, express or implied, is made.

Variations in both the nature and extent of the subsurface conditions could be observed during construction. Standard test methods are referenced in this structures report. Other standards or documents referenced in any given standard cited in this report, or otherwise relied upon by the authors of this report, are only mentioned in the given standard; they are not incorporated into it or "included by reference," as that latter term is used relative to contracts or other matters of law.

REFERENCES

Commonwealth of Virginia, Department of Mines, Minerals and Energy, Division of Mineral Resources (1993), *Geologic Map of Virginia*. https://www.dmme.virginia.gov/commerce/

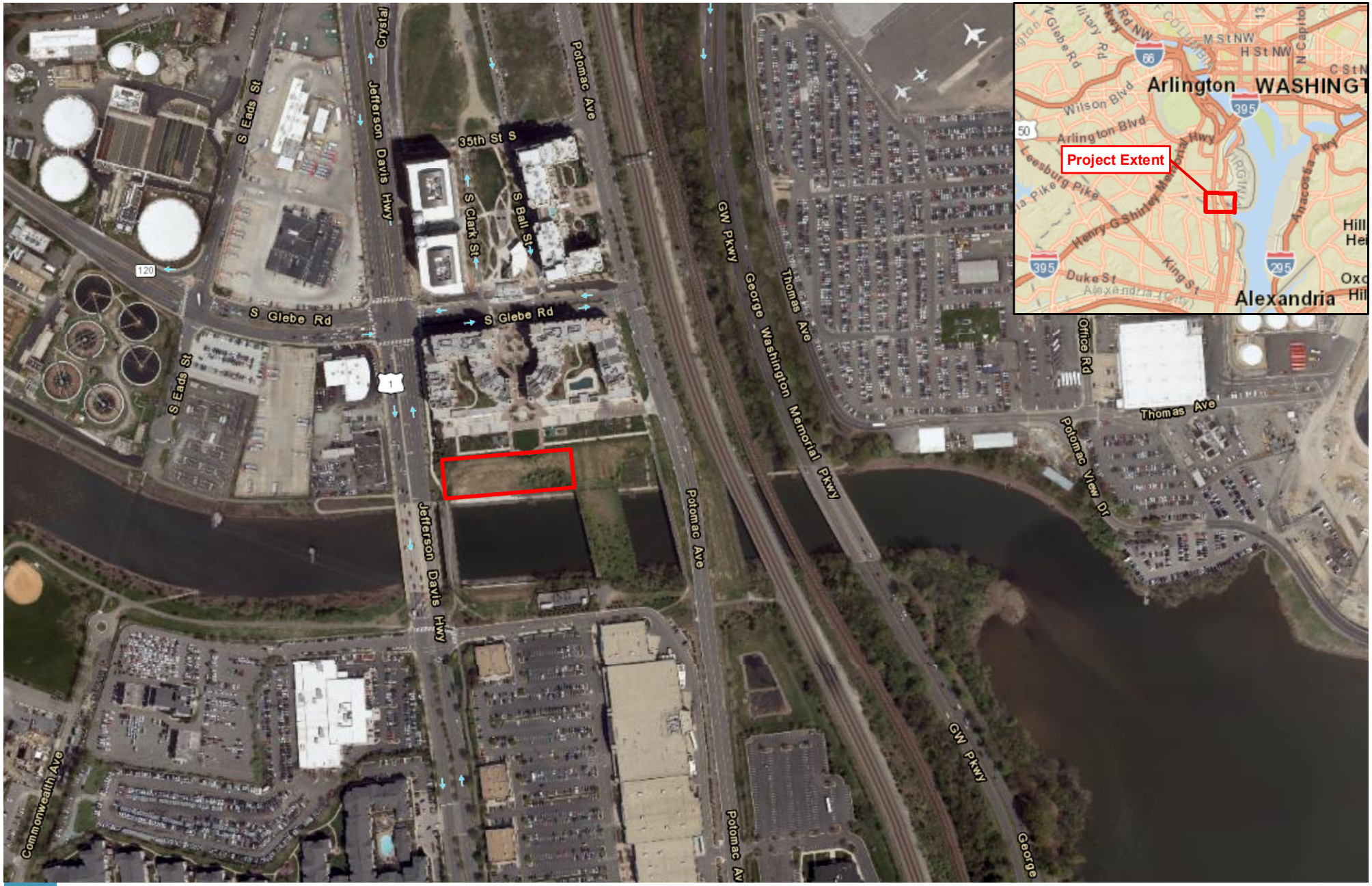
Virginia Department of Transportation (2014), *Geotechnical Manual for Structures-Chapter 3: Geotechnical Engineering*.

American Association of State Highway and Transportation Officials, (2016), *LRFD Bridge Design Specifications.*

APPENDIX A

DRAWINGS AND TABLES

Figure 1: Site Vicinity Map
Figure 2: Boring Location and Proposed Grading Plan
Figure 3: Subsurface Fence Diagram
Figure 4: Critical Slope Geometry
Figure 5: Proposed Cross Sections



Project Area

1 inch = 400 feet

0 Feet 400

DATA SOURCE: 2013 VGIN Aerial Imagery, ESRI World Transportation

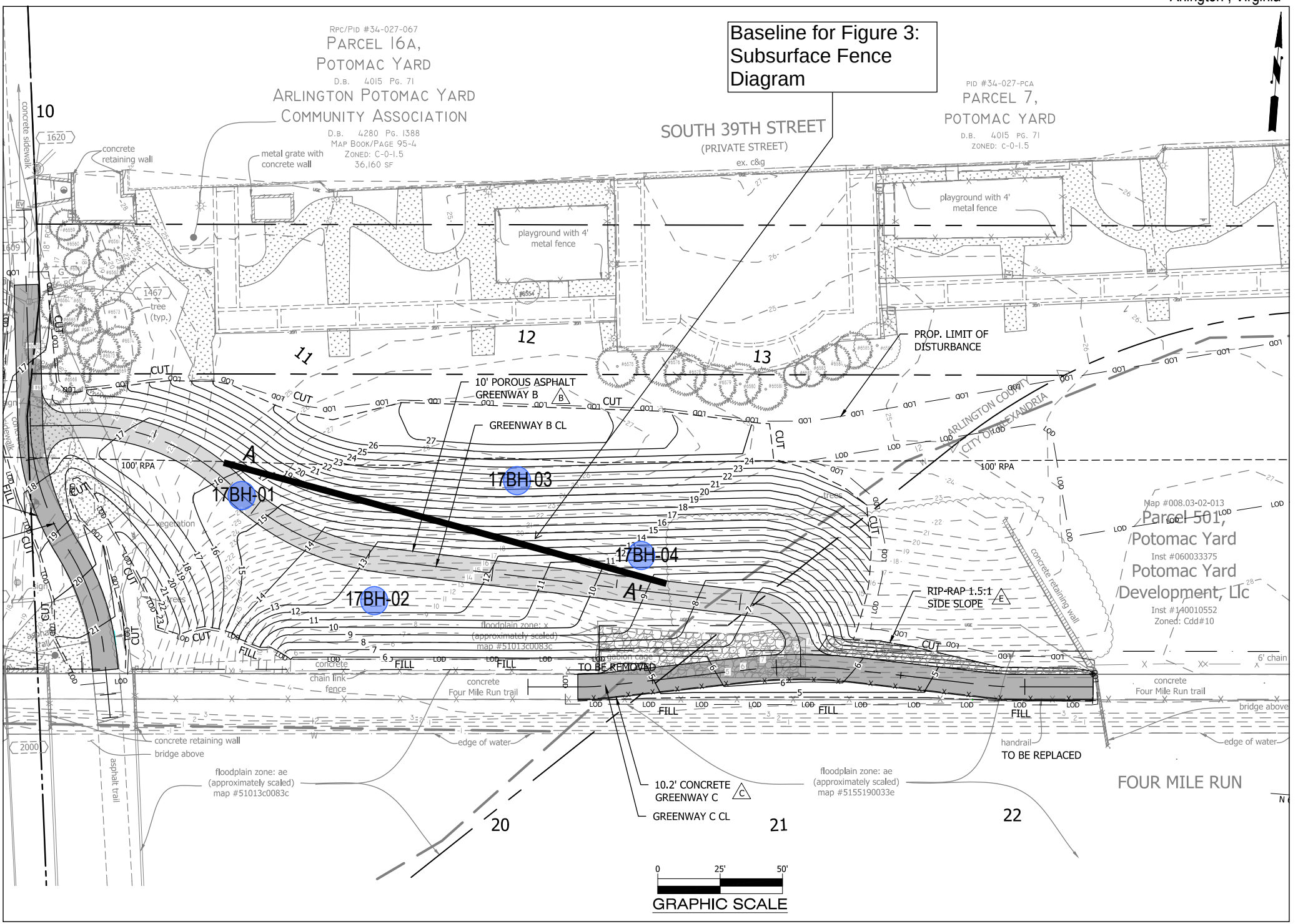
POTOMAC YARD - FOUR MILE RUN TRAIL CONNECTION

SITE VICINITY MAP

FIGURE 1

PATH: \\CLTSMAIN\GIS_DATA\GIS\G_TEMP\BRWARD\FOURMILERUN_TRAIL\FIG_1_SITEVICINITY.MXD - USER: BRWARD - DATE: 9/18/2017

Figure 2: Boring Location and Proposed Grading Plan
Four Mile Run Trail
Arlington , Virginia



Note: Borings have been plotted on a proposed grade drawing obtained from 60% plans provided to Arlington, Virginia, by ALTA Planning and Design Inc.

4470 Cox Rd Suite 200
Glen Allen, VA
Telephone: (804) 663-7358

Subsurface Fence Diagram
Figure 3

Topsoil
USCS Low Plasticity Silty Clay
USCS Silty Sand
USCS Clayey Sand
USCS Poorly-graded Sand with Clay
USCS Low Plasticity Clay
USCS Poorly-graded Sand

CLIENT Kittelson & Associates, Inc.
PROJECT NUMBER 10055101
PROJECT NAME 4 Mile Run Trail
PROJECT LOCATION Arlington County, VA

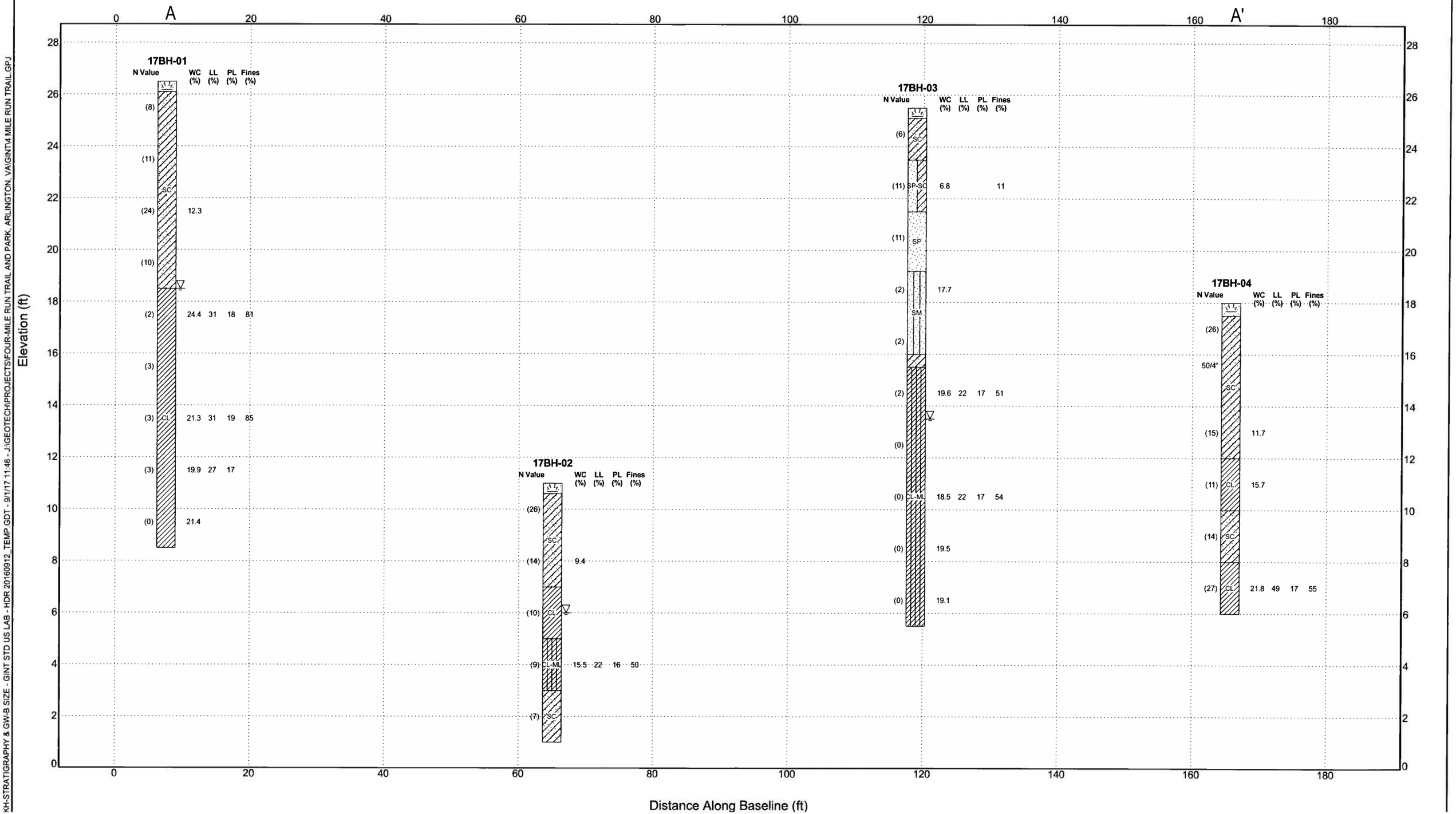
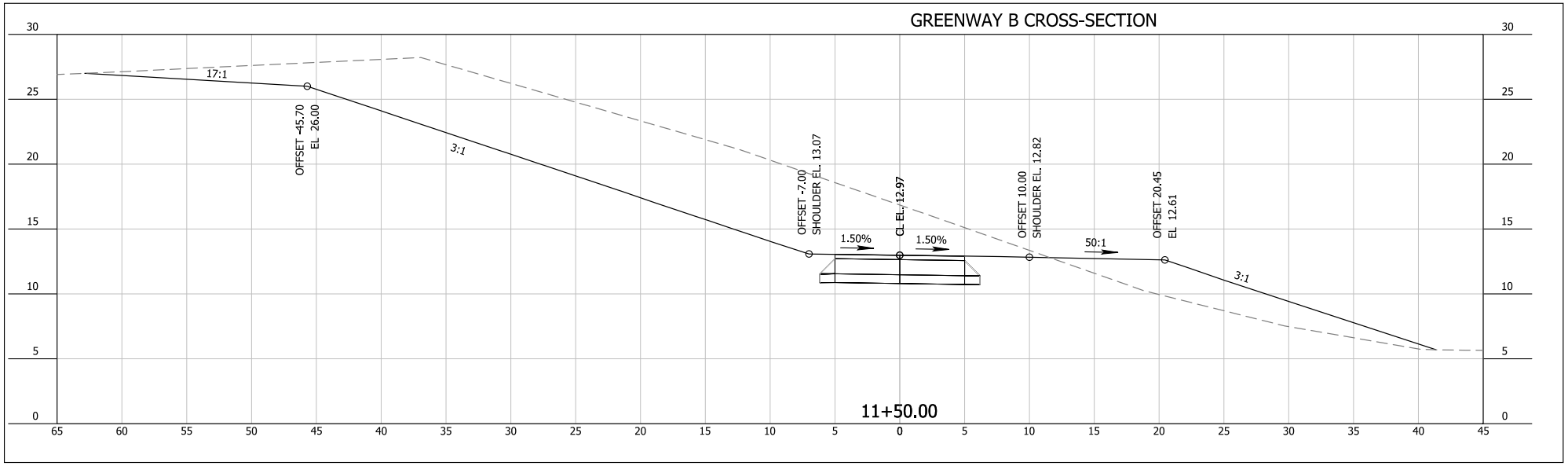


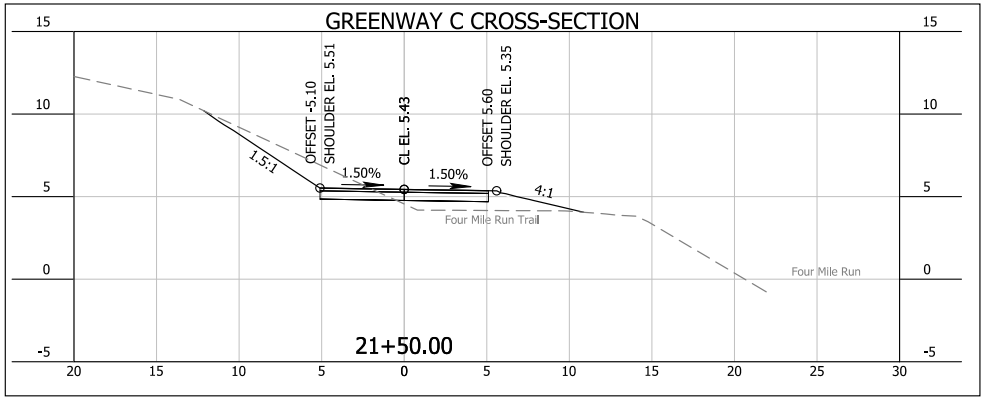
Figure 4: Critical Slope Geometry
Four Mile Run Trail
Arlington , Virginia

Cut and Fill Slope



Note: Proposed Greenway B Cross-Section obtained from 60% plans provided to Arlington, Virginia, by ALTA Planning and Design Inc.

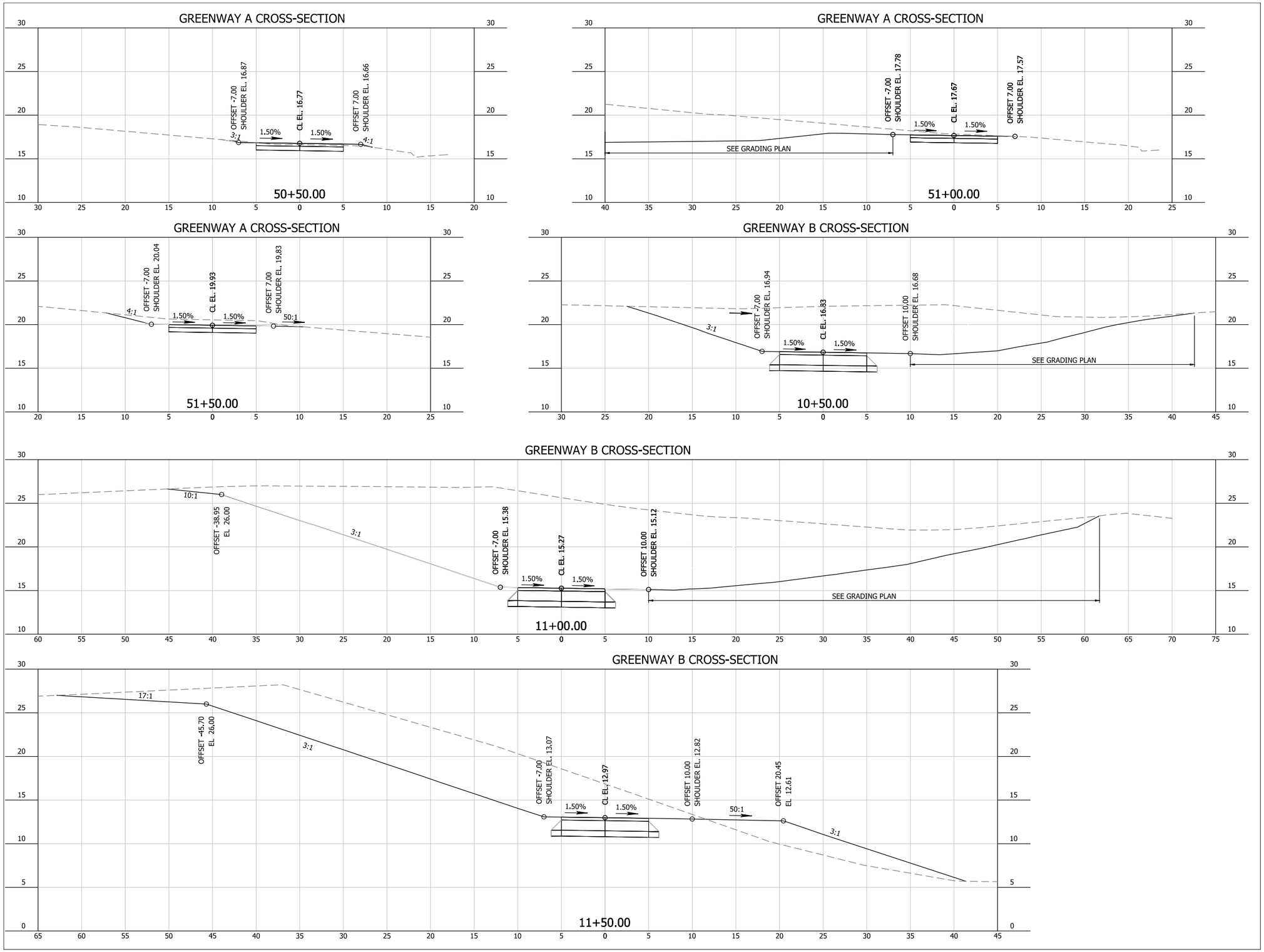
Rip Rap Slope



Note: Proposed Greenway C Cross-Section obtained from 60% plans provided to Arlington, Virginia, by ALTA Planning and Design Inc.

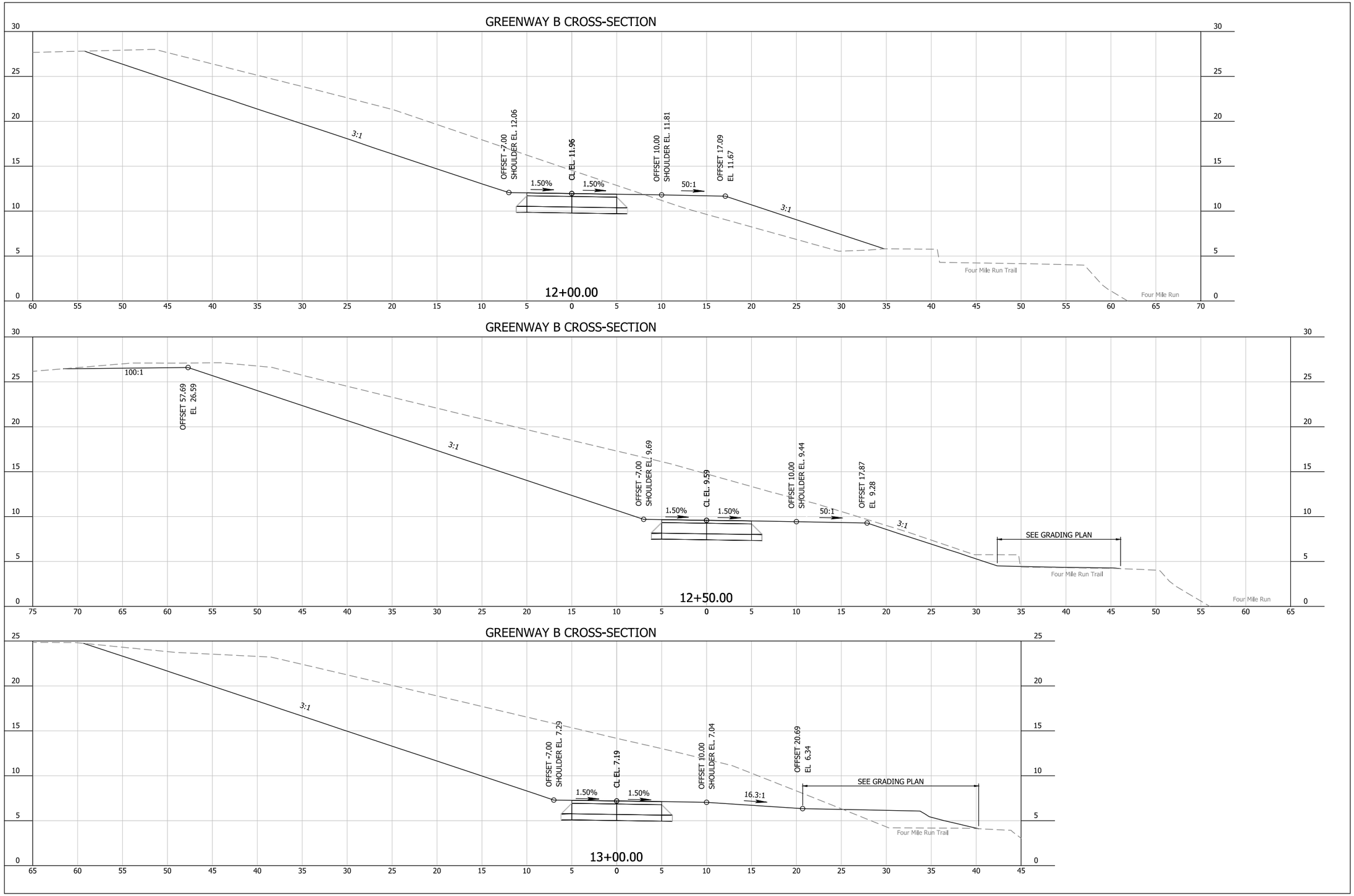
Figure 5a: Proposed Cross Sections

Four Mile Run Trail
Arlington , Virginia



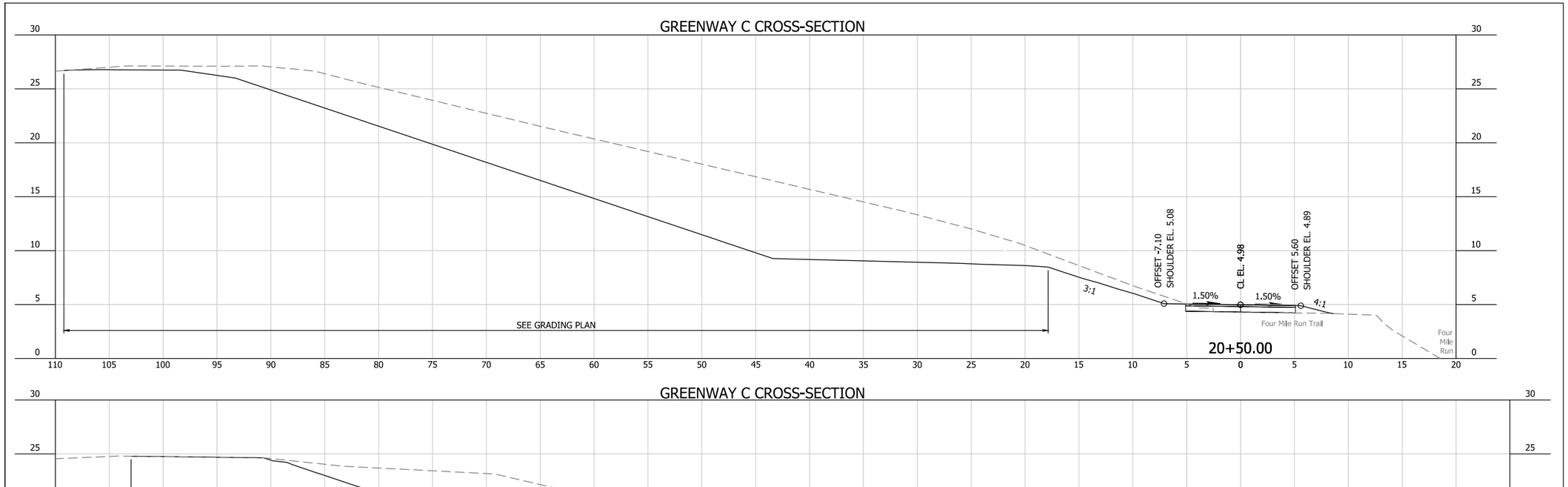
Note: Proposed cross section drawings obtained from 60% plans provided to Arlington, Virginia, by ALTA Planning and Design Inc.

Figure 5b: Proposed Cross Sections
Four Mile Run Trail
Arlington , Virginia



Note: Proposed cross section drawings obtained from 60% plans provided to Arlington, Virginia, by ALTA Planning and Design Inc.

Figure 5c: Proposed Cross Sections
Four Mile Run Trail
Arlington , Virginia



Note: Proposed cross section drawings obtained from 60% plans provided to Arlington, Virginia, by ALTA Planning and Design Inc.

APPENDIX B

SUBSURFACE EXPLORATION DATA

Subsurface Exploration Logs
Field Soil Descriptions –HDR Soil Logging
HDR Materials and Sample Symbols List

4470 Cox Rd Suite 200
Glen Allen, VA
Telephone: (804) 663-7358

BORING NUMBER 17BH-01

CLIENT Kittelson & Associates, Inc. **PROJECT NAME** 4 Mile Run Trail

PROJECT NUMBER 10055101 **PROJECT LOCATION** Arlington County, VA

NORTH 14111409.18 **EAST** 1056156.655 **DATE STARTED** 8/21/17 **COMPLETED** 8/21/17

STATION 10+75 **OFFSET** --- **GROUND ELEVATION** 26.5 ft **HOLE SIZE** 7"

DRILLING CONTRACTOR SaLUT, Inc. **GROUND WATER LEVELS:**

DRILLING METHOD 3.25" HSA w/ SPTs **AT TIME OF DRILLING** 8.0 ft / Elev 18.5 ft

LOGGED BY Kohltan Heiter, EIT/HDR **CHECKED BY** Joe Wallen, PE/HDR **AT END OF DRILLING** --- Cave-in @ 15.5 ft

NOTES Automatic hammer **AFTER DRILLING** ---

DEPTH (ft)	ELEV (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0	26.5		0.0/26.5 5" Topsoil										
	25		0.4/26.1 FILL: brown and gray, fine to coarse CLAYEY SAND (SC), loose, dry, contains organic material and asphalt fragments	SPT 1	75	3-4-4-4 (8)							
			2.0/24.5 FILL: brown, fine to coarse CLAYEY SAND (SC), medium dense, dry	SPT 2	65	3-5-6-5 (11)							
5			4.0/22.5 FILL: brown and black, fine to coarse CLAYEY SAND (SC), medium dense, dry, contains pocket of concrete fragments 5.7 to 6.0 ft bgs	SPT 3	100	5-7-17-11 (24)			12				
	20		6.0/20.5 FILL: brown and gray, fine to coarse CLAYEY SAND WITH GRAVEL (SC), medium dense, dry, contains concrete fragments	SPT 4	50	6-6-4-2 (10)							
			8.0/18.5 Orange and brown, LEAN CLAY WITH SAND (CL), soft, wet	SPT 5	60	WOH/12"-2-1 (2)	1.75		24	31	18	13	81
10			10.0/16.5 Brown and gray, SANDY LEAN CLAY (CL), soft, moist	SPT 6	65	1-1-2-2 (3)	1.0						
	15		12.0/14.5 Brown and gray, LEAN CLAY (CL), soft, moist	SPT 7	100	WOH-1-2-2 (3)	1.0		21	31	19	12	85
15			14.0/12.5 Brown and gray, mottled, LEAN CLAY (CL), soft, moist	SPT 8	75	WOH-1-2-1 (3)	1.25		20	27	17	10	
	10		16.0/10.5 Gray and brown, SANDY LEAN CLAY (CL), very soft, wet	SPT 9	80	WOH/18"-2	0.5		21				

Bottom of borehole at 18.0 feet.
Boring backfilled with grout.

Latitude: 38.841308 Longitude: -77.051911

4470 Cox Rd Suite 200
Glen Allen, VA
Telephone: (804) 663-7358

BORING NUMBER 17BH-02

CLIENT Kittelson & Associates, Inc.
PROJECT NAME 4 Mile Run Trail
PROJECT NUMBER 10055101
PROJECT LOCATION Arlington County, VA
NORTH 14111373.03 **EAST** 1056209.121
DATE STARTED 8/21/17 **COMPLETED** 8/21/17
STATION 11+25 **OFFSET** ---
GROUND ELEVATION 11 ft **HOLE SIZE** 7"
DRILLING CONTRACTOR SaLUT, Inc.
GROUND WATER LEVELS:
DRILLING METHOD 3.25" HSA w/ SPTs
▽ **AT TIME OF DRILLING** 5.0 ft / Elev 6.0 ft
LOGGED BY Kohltan Heiter, EIT/HDR **CHECKED BY** Joe Wallen, PE/HDR
AT END OF DRILLING --- Cave-in @ 7.5 ft
NOTES Manual hammer
AFTER DRILLING ---

DEPTH (ft)	ELEV (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0	10		0.0/11.0 5" Topsoil	SPT 1	20	4-14-12-12 (26)							
			0.4/10.6 FILL: brown, fine to medium CLAYEY SAND (SC), medium dense, dry, contains organic matter 2.0/9.0 Brown, fine CLAYEY SAND (SC), medium dense, dry	SPT 2	50	5-7-7-5 (14)			9				
5	5		4.0/7.0 ▽ Gray, SANDY LEAN CLAY (CL), firm, wet	SPT 3	100	6-5-5-6 (10)	1.0						
			6.0/5.0 Brown and gray, mottled, SANDY SILTY CLAY (CL-ML), firm, moist	SPT 4	75	3-4-5-4 (9)	1.5		16	22	16	6	50
10			8.0/3.0 Brown, fine to medium CLAYEY SAND (SC), loose, wet	SPT 5	75	4-3-4-2 (7)	1.0						

Bottom of borehole at 10.0 feet.
Boring backfilled with grout.

Latitude: 38.841212 Longitude: -77.051724

4470 Cox Rd Suite 200
Glen Allen, VA
Telephone: (804) 663-7358

BORING NUMBER 17BH-03

CLIENT Kittelson & Associates, Inc.
PROJECT NAME 4 Mile Run Trail
PROJECT NUMBER 10055101
PROJECT LOCATION Arlington County, VA
NORTH 14111422.27 **EAST** 1056271.483
DATE STARTED 8/21/17 **COMPLETED** 8/21/17
STATION 12+00 **OFFSET** ---
GROUND ELEVATION 25.5 ft **HOLE SIZE** 7"
DRILLING CONTRACTOR SaLUT, Inc.
GROUND WATER LEVELS:
DRILLING METHOD 3.25" HSA w/ SPTs
▽ **AT TIME OF DRILLING** 12.0 ft / Elev 13.5 ft
LOGGED BY Kohltan Heiter, EIT/HDR **CHECKED BY** Joe Wallen, PE/HDR
AT END OF DRILLING --- Cave-in @ 16.0 ft
NOTES Automatic Hammer
AFTER DRILLING ---

DEPTH (ft)	ELEV (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0	25		0.0/25.5 5" Topsoil	SPT 1	75	2-1-5-4 (6)							
			0.4/25.1 FILL: brown, fine to medium CLAYEY SAND (SC), loose, moist, contains organic material and pocket of aphalt cinders 1.5 to 2.0 ft bgs	SPT 2	65	4-6-5-8 (11)			7				11
			2.0/23.5 FILL: brown, fine to medium POORLY GRADED SAND WITH CLAY (SP-SC), medium dense, moist										
5	20		4.0/21.5 FILL: light brown, fine to medium POORLY GRADED SAND (SP), medium dense, moist	SPT 3	65	4-6-5-5 (11)							
			6.3/19.2 FILL: black, fine to medium SILTY SAND (SM), very loose, moist, contains asphalt cinders	SPT 4	65	2-1-1-1 (2)			18				
				SPT 5	75	2-1-1-1 (2)							
10	15		9.5/16.0 Brown, fine to medium CLAYEY SAND (SC), moist										
			10.0/15.5 Brown and orange, SANDY SILTY CLAY (CL-ML), soft, moist	SPT 6	100	2-1-1-2 (2)	0.5		20	22	17	5	51
		▽	12.0/13.5 Brown and orange, SANDY SILTY CLAY (CL-ML), very soft, wet	SPT 7	75	WOH/18"-2	1.0						
15	10		14.0/11.5 Brown and orange, SANDY SILTY CLAY (CL-ML), very soft, wet	SPT 8	100	WOH/24"	0.5		19	22	17	5	54
			16.0/9.5 Gray and brown, SANDY SILTY CLAY (CL-ML), very soft, wet	SPT 9	100	WOH/24"	0.25		20				
20				SPT 10	75	WOH/24"	0.25		19				

Bottom of borehole at 20.0 feet.
Boring backfilled with grout.

Latitude: 38.841351 Longitude: -77.051509

4470 Cox Rd Suite 200
Glen Allen, VA
Telephone: (804) 663-7358

BORING NUMBER 17BH-04

CLIENT Kittelson & Associates, Inc. **PROJECT NAME** 4 Mile Run Trail
PROJECT NUMBER 10055101 **PROJECT LOCATION** Arlington County, VA
NORTH 14111392.89 **EAST** 1056314.129 **DATE STARTED** 8/21/17 **COMPLETED** 8/21/17
STATION 12+50 **OFFSET** --- **GROUND ELEVATION** 18 ft **HOLE SIZE** 7"
DRILLING CONTRACTOR SaLUT, Inc. **GROUND WATER LEVELS:**
DRILLING METHOD 3.25" HSA w/ SPTs **AT TIME OF DRILLING** ---
LOGGED BY Kohltan Heiter, EIT/HDR **CHECKED BY** Joe Wallen, PE/HDR **AT END OF DRILLING** --- Cave-in @ 8.0 ft
NOTES Manual hammer **AFTER DRILLING** ---

DEPTH (ft)	ELEV (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0			0.0/18.0 6" Topsoil										
			0.5/17.5 FILL: brown, fine to medium CLAYEY SAND (SC), medium dense, dry, contains organic material, asphalt fragments, and concrete fragments	SPT 1	85	2-9-17-50 (26)							
	15			SPT 2	88	49-50/4"							
			2.0/16.0 FILL: brown, fine to medium CLAYEY SAND (SC), very dense, dry, contains pocket of concrete fragments 2.5 to 2.8 ft bgs, contaings organic material										
5			4.0/14.0 FILL: brown and orange, fine to coarse CLAYEY SAND (SC), medium dense, dry	SPT 3	60	15-5-10-9 (15)			12				
			6.0/12.0 FILL: brown and orange, SANDY LEAN CLAY (CL), firm, moist	SPT 4	50	5-5-6-7 (11)			16				
	10												
			8.0/10.0 FILL: brown gray, fine to medium CLAYEY SAND (SC), medium dense, dry	SPT 5	35	2-6-8-12 (14)							
10													
			10.0/8.0 Gray and orange, mottled, SANDY LEAN CLAY (CL), very stiff, moist	SPT 6	50	24-16-11-19 (27)	3.0		22	49	17	32	55

Bottom of borehole at 12.0 feet.
Boring backfilled with grout.

Latitude: 38.841273 Longitude: -77.051357

SOIL BORING
KEY TO FIELD LOGGING

ORDER OF SOIL DESCRIPTION

1. **Geologic Origin** – See Table 1 on page 2
2. **Color** – Comprises more than 50% of the sample, to be written in ALL CAPS
3. **Primary/Major Grain Size** – "**and**": 30% to 50% of the minor grain size
4. **Modifying Term** – "**some**": 15% to 30% of the minor grain size
   "**little**": 5% to 15% of the minor grain size
   "**trace**": 5% or less of the minor grain size
5. **Secondary Component(s)** – Can have up to two, but total must not exceed 100%
6. **Contains** – See Table 2 on page 2
7. **Soil Density/Consistency** – "**dry**": Absence of moisture, dusty, dry to the touch
8. **Moisture Content** – "**moist**": Damp but no visible water
   "**wet**": Visible free water, usually soil is below water table

EXAMPLES OF SOIL DESCRIPTION:

- Residual, Yellow-brown, fine, SANDY ELASTIC SILT, trace gravel, slightly micaceous medium stiff, moist (MH)
- Fill, Brown and gray, fine to coarse, SILTY SAND RUBBLE FILL, trace gravel, contains glass, brick and rock fragments, contains pockets of fat clay, loose, moist (SM)

OTHER INFORMATION TO BE PROVIDED ON FIELD LOG:

- Include logger's and driller's first and last name and company
- Provide type of drill rig, size of augers, type of hammer (automatic or manual)
- Indicate field offset direction and distance from staked location, if applicable
- Identify type of ground cover (leaf litter, asphalt, topsoil), and provide depth in inches (i.e., Topsoil 4")
- Pavement – record thickness of pavement and aggregate subbase in inches (i.e., Asphalt 5", Aggregate subbase 12")
- Indicate if material is **Fill or Potential Fill**
- Record depth to water and cave in at time of boring (TOB) (and after 24-hours, if applicable)
- Auger; refusal depth, spoon, or roller cone bit; if applicable (i.e., AR at 14.6 ft)
- Boring termination depth (i.e., BOH 20.0 ft)
- Note backfill methods
- Include comments regarding location, if applicable (i.e., located in shoulder, adjacent to stream, bridge approach, etc.)
- Use shovel for determining thickness of topsoil

"CONTAINS":

Under "Comments", note the presence of shell fragments, wood fragments, type/condition of organics (roots/root fragments, branches, leaves, grass/decomposed, fresh, etc.), unusual odors, contamination by other man-made materials (construction material, concrete, asphalt pavement debris, wire, brick, glass, etc.). If the portion of the foreign matter represents more than 30% (by weight) of the soil component, then include statements such as *"contains heavy concentrations of ____"*.

When noting **mica content**, eliminate the word "contains" and use one of the following expressions: *slightly micaceous* (few shiny flakes), *micaceous* (common throughout soil), or *highly micaceous* (soil is almost all mica).

"Contains" should also be used to identify lenses, layers, or pockets of distinctly different material than the parent soil of the sample. See descriptions below:

Description	Criteria
Frequent	More than one per foot of thickness
Interbedded	Alternating soil layers of different composition
Layer	Material lying essentially parallel to the surfaces against which it was formed (generally 1 to 6 inches)
Lens	A lenticular deposit, larger than a pocket (generally less than 1 inch thick)
Occasional	One or less per foot of thickness
Parting	A very thin granular layer
Pocket	Small erratic deposits that are isolated within the total soil matrix
Seam	A thin layer separating two distinctive layers of different composition or greater magnitude
Stratified	Alternating layers of varying material or color
Stratum	A stratigraphic unit

SAMPLE TYPES S: Split Spoon: ST: Shelby Tube (Examples: S-1, S-2, ST-1, S-3, etc.)

COMPONENT	DISTINGUISHED FEATURES
Boulders	Larger than 12" (300 mm)

SOIL BORING
KEY TO FIELD LOGGING

Cobbles 3" to 12" (75 mm to 12 mm)

Gravel Larger than No. 4 sieve and smaller than a 3" sieve
Described with any of the following terms (or any combination):
Fine 3/8" to No. 4 use fine, coarse, or fine to coarse (9.5 mm to 4.75 mm) sieve
Coarse 3" to ¾" (75 mm to 19 mm) sieve
Use fine, coarse, or fine to coarse; do not use medium
Provide angular or rounded

Sand The finest sand grains are just visible to the naked eye; while the largest would pass a No. 4 (4.75mm) sieve (pinhead size). Described with any of the following terms (or any combination):
Fine No. 40 to No. 200 (0.42 mm to 0.075 mm) sieve
Medium No. 10 to No. 40 (2.0 mm to 0.42 mm) sieve
Coarse No. 4 to No. 10 (4.75 mm to 2.0 mm) sieve
Use fine to coarse, fine to medium, medium to coarse, etc.

Silt Lumps are easily crumbled when are dried
Feels gritty between the teeth
A moist pat when shaken in the palm of the hand will appear shiny wet
When squeezed it will appear dry and dull
Identify whether SILT (ML) or elastic SILT (MH)

Clay Lumps are comparatively hard when air- dried
Threads (1/8" diameter) of considerable length will support their own weight when held by one end
A moist pat will appear the same whether shaken in the palm of the hand or squeezed.
Identify whether lean CLAY (CL) or fat CLAY (CH)

TABLE 1: GEOLOGIC ORIGIN

Residual	Unconsolidated or partly weathered parent material, developed in place by weathering
Palustrine	Material grown or deposited in a marsh or marsh-like environment
Alluvial	Material deposited by a stream or running water
Fill	Distinguish between trash fill and rubble fill
Intermediate Geomaterials (IGM)	Describes material as it transactions between soil and rock, and vice-versa. **See below***
***Residual material (has rock structure) w/ SPT N-Values > 50 blows per 6"**	
***Strength is greater than soil and less than the weathered rock**	

TABLE 2: COLOR (not limited to…)

Brown	Gray	Black	Orange	Yellow	Blue	Green
Red-brown	Gray-brown	Green-gray	Orange-brown	Yellow-brown	Blue-gray	Red
Use "Light" and "Dark" as modifiers						
"Mottled" – irregularly marked with spots or patches of different colors; i.e. brown with gray mottles						

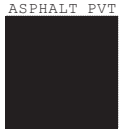
TABLE 3: RELATIVE DENSITY / CONSISTENCY TABLE

Sands		**Silts and Clays**			
N60	**Relative Density**	**N60**	**Field Test***	**Unconfined Compressive Strength (tsf –e.g., from Pocket Penetrometer)***	**Consistency**
0-3	Very Loose	0-1	Extruded between fingers when squeezed	<0.25	Very Soft
4-9	Loose	2-4	Molded by light finger pressure	0.25-0.5	Soft
10-29	Medium Dense	5-8	Molded by strong finger pressure	0.5-1.0	Firm
30-50	Dense	9-15	Readily indented by thumb but penetrated with great effort	1.0-2.0	Stiff
Over 50	Very Dense	16-30	Readily indented by thumbnail	2.0-4.0	Very Stiff
		31-60	Indented with difficulty by thumbnail	Over 4.0	Hard
		Over 60	-	-	Very Hard

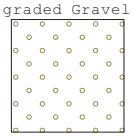
MATERIAL AND SAMPLE SYMBOLS LIST

Pavement/Soils

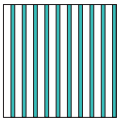
ASPH- ASPHALT PVT



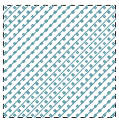
GP - Poorly-graded Gravel



MH - Elastic Silt

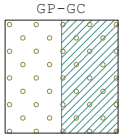


SC - Clayey Sand

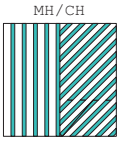


CH - Fat Clay

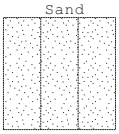
GP-GC



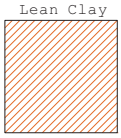
MH/CH



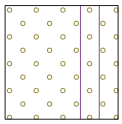
SM - Silty Sand



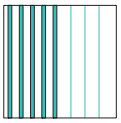
CL - Lean Clay



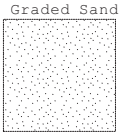
GP-GM



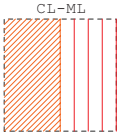
MH/ML



SP - Poorly-Graded Sand

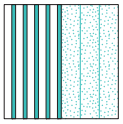


CL-ML

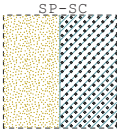


GW - Well-Graded Gravel

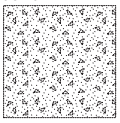
MH/SM



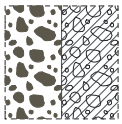
SP-SC



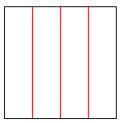
CONC- CONCRETE PVT



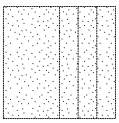
GW-GC



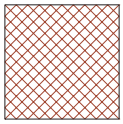
ML - Silt



SP-SM

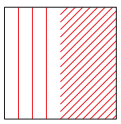


FL -Fill



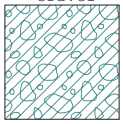
GW-GM

ML/CL

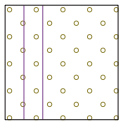


SW - Well-Graded Sand

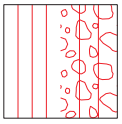
GC - Clayey Gravel



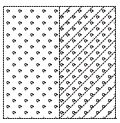
GM/GP



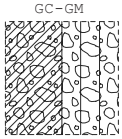
ML/GM



SW-SC

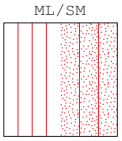


GC-GM

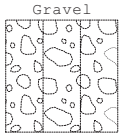


GM/ML

ML/SM



GM - Silty Gravel

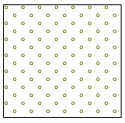


GM/SM

SW-SM

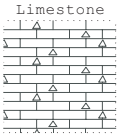
Sedimentary Rocks

CGL - Conglomorate

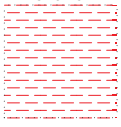


SE - Shell Bed

CLST - Cherty Limestone



SHL - Shale



COL - Coal

SLS - Siltstone

MST Mudstone

SST - Sandstone

GWK - Graywacke

SST-SHL - Interbedded Sandstone/Shale

LST - Limestone

SST-SLS - Interbedded Sandstone/Siltstone

UCY - Underclay

SHLS-Shaly Limestone

SHDS Shaly Dolostone

MSH Silty Shale

CHK Chalk

SSHL Sandy Shale

Igneous Rocks

AND - Andesite

BST - Basalt

DBS - Diabase

DRT - Diorite

GBR - Gabbro

GRD - Granodiorite

GRN Granite

POR - Porphyry

RHY - Rhyolite

Metamorphic Rocks

GGE - Gouge

GNS - Gneiss

MYL - Mylonite

PHY - Phyllite

SCH - Schist

SLT - Slate

Misc.

CAV - Cavity

HWR Highly Weathered Rock

BRC - Breccia

Sampling

SPT

Core

Auger

Vane

Undisturbed

Grab

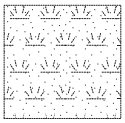
No Recovery

Other

MATERIAL AND SAMPLE SYMBOLS LIST

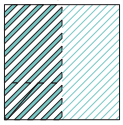
Pavement/Soils

TOPS- TOPSOIL



SC/CH

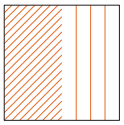
CH/CL



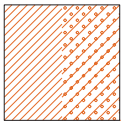
CH/MH

CH/SC

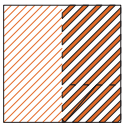
CL/ML



CL/SC

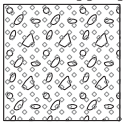


CL/CH

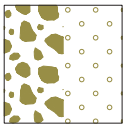


GP/GW

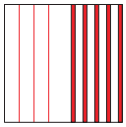
CRA Crushed Aggregate



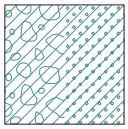
GW/GP



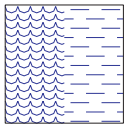
ML/MH



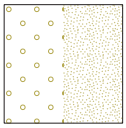
GC/SC



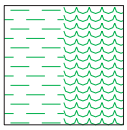
OH/OL



GP/SP

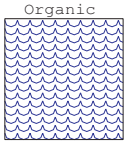


OL/OH

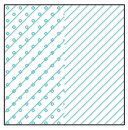


PT Peat

OH Organic



SC/CL



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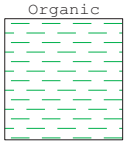
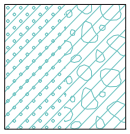
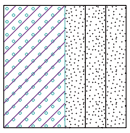


SC/GC

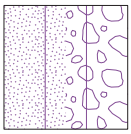


SC-SM

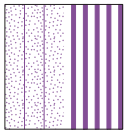


SP/SW

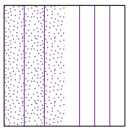
SM/GM



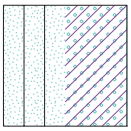
SM/MH



SM/ML



SM/SC



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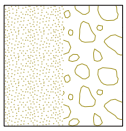
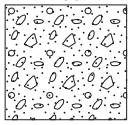


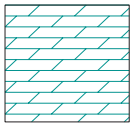
SW/SP

Sedimentary Rocks

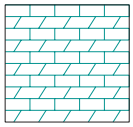
BLD-Boulder Bed



DLS Dolostone

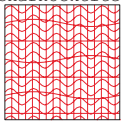


LST-DLS- Interbedded Limestone/Dolostone



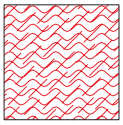
Igneous Rocks

CHT Charnocktite

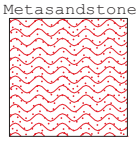


Metamorphic Rocks

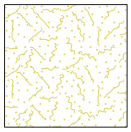
MSLS Metasiltstone



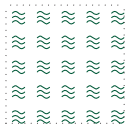
MSST Metasandstone



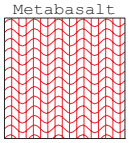
QZT - Quartzite



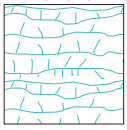
SPS Soapstone



MBST Metabasalt



MBL Marble



Sampling

APPENDIX C

GEOTECHNICAL LABORATORY TESTING DATA

Laboratory Summary Tables
Atterberg Limit Test Results
Grain Size Analysis Results
Hydrometer Test Results

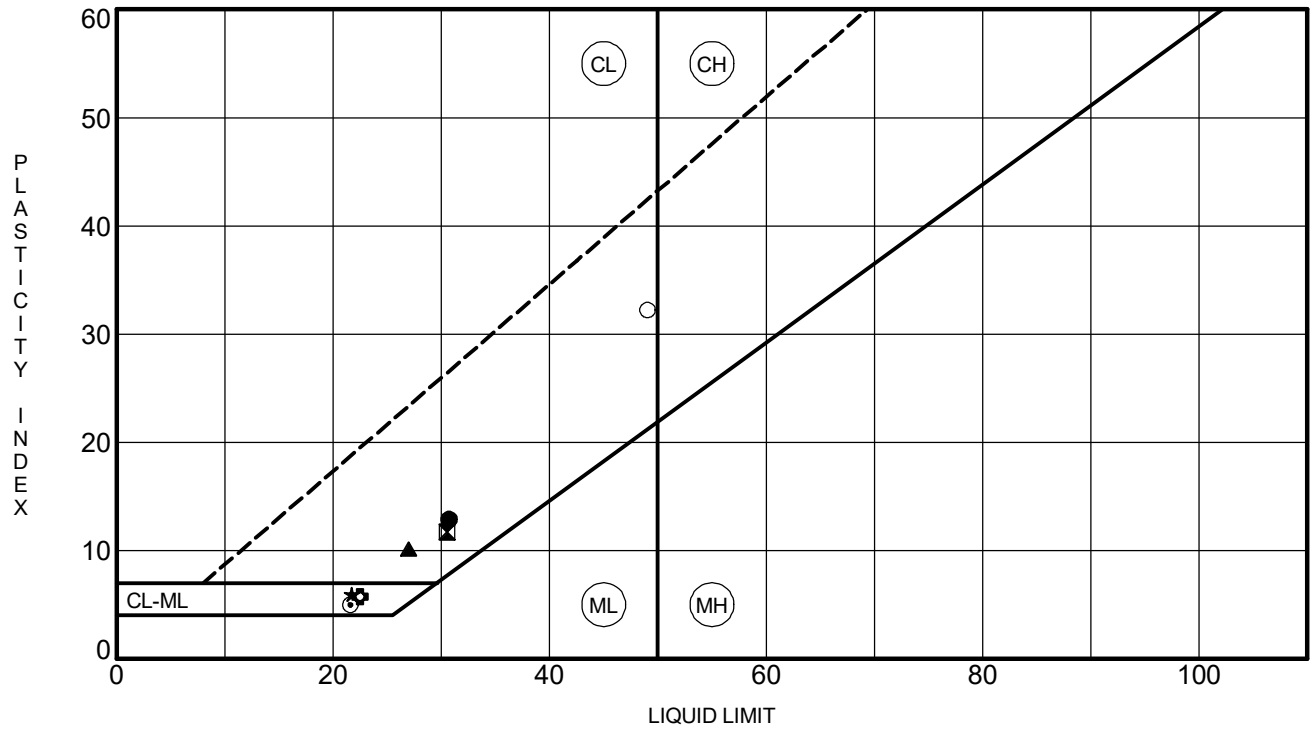
Boring	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	% < #4 Sieve	% < #200 Sieve	Classification	Water Content (%)
17BH-01	4.0-6.0							12.3
17BH-01	8.0-10.0	31	18	13		81	CL	24.4
17BH-01	12.0-14.0	31	19	12	100	85	CL	21.3
17BH-01	14.0-16.0	27	17	10				19.9
17BH-01	16.0-18.0							21.4
17BH-02	2.0-4.0							9.4
17BH-02	6.0-8.0	22	16	6		50	CL-ML	15.5
17BH-03	2.0-4.0					11		6.8
17BH-03	6.0-8.0							17.7
17BH-03	10.0-12.0	22	17	5		51	CL-ML	19.6
17BH-03	14.0-16.0	22	17	5	100	54	CL-ML	18.5
17BH-03	16.0-18.0							19.5
17BH-03	18.0-20.0							19.1
17BH-04	4.0-6.0							11.7
17BH-04	6.0-8.0							15.7
17BH-04	10.0-12.0	49	17	32		55	CL	21.8

Summary of Laboratory Results

T.O 20 - South Park, 4-mile Run Trail

Arlington, Virginia

Project Number: 17-0043 (HDR Project# 10055101)



	Boring	Depth	LL	PL	PI	Fines	Classification
●	17BH-01	8.0-10.0	31	18	13	81	LEAN CLAY with SAND(CL)
⊠	17BH-01	12.0-14.0	31	19	12	85	LEAN CLAY with SAND(CL)
▲	17BH-01	14.0-16.0	27	17	10		
★	17BH-02	6.0-8.0	22	16	6	50	SANDY SILTY CLAY(CL-ML)
⊙	17BH-03	10.0-12.0	22	17	5	51	SANDY SILTY CLAY(CL-ML)
✿	17BH-03	14.0-16.0	22	17	5	54	SANDY SILTY CLAY(CL-ML)
○	17BH-04	10.0-12.0	49	17	32	55	SANDY LEAN CLAY(CL)

Test Method: ASTM D4318

Tested By: JW Date: 8/28/2017

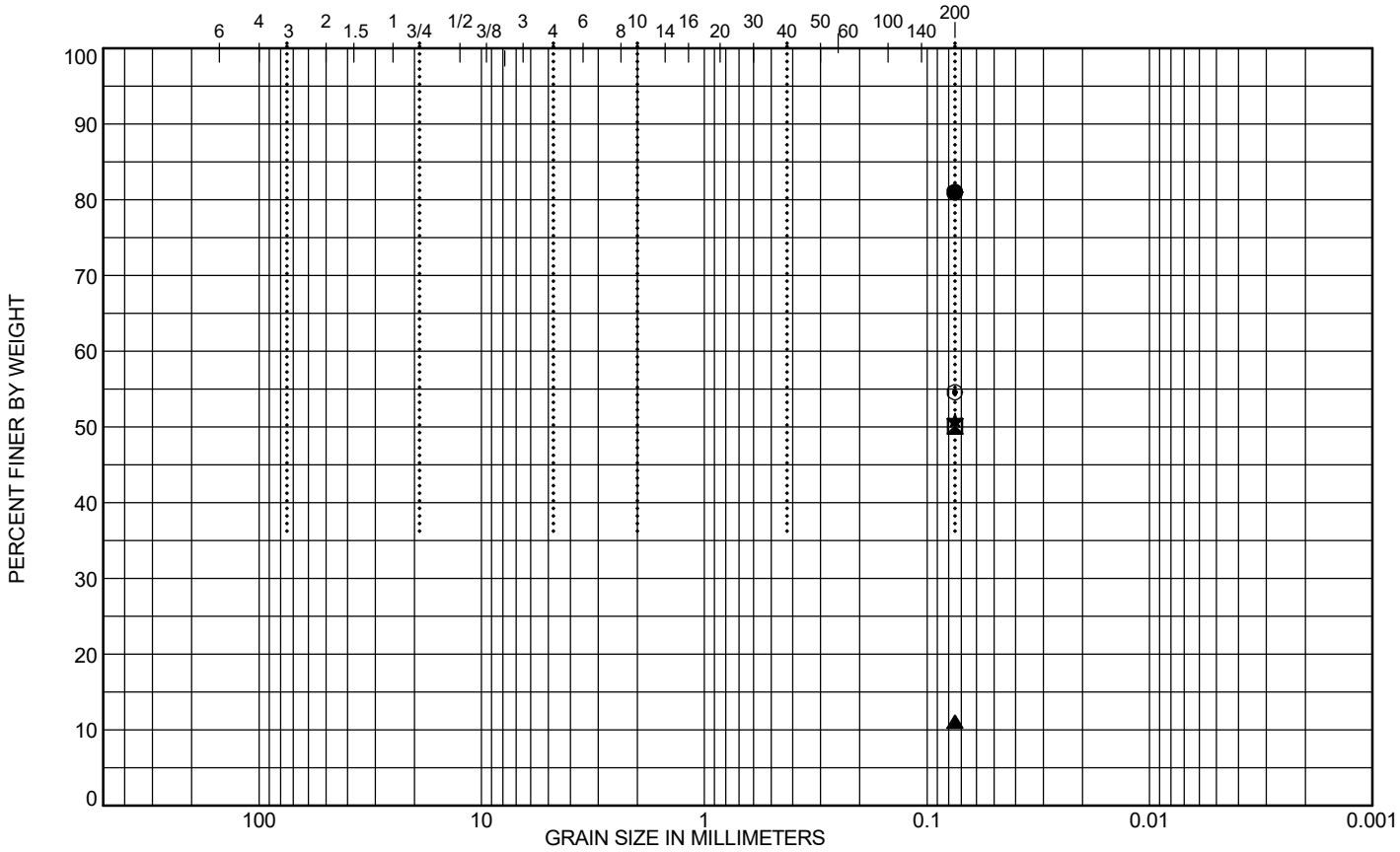
ATTERBERG LIMITS' RESULTS

Project: T.O 20 - South Park, 4-mile Run Trail

Location: Arlington, Virginia

Project Number: 17-0043 (HDR Project# 10055101)

TLB ATTERBERG LIMITS 17-0043 LAB.GPJ TLB2009.GDT 8/31/17



	D10	D30	D60	D100
●				
⊠				
▲				
★				
⊙				

Test Method: ASTM D422

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Tested By: EM, JW Date: 8/28/2017

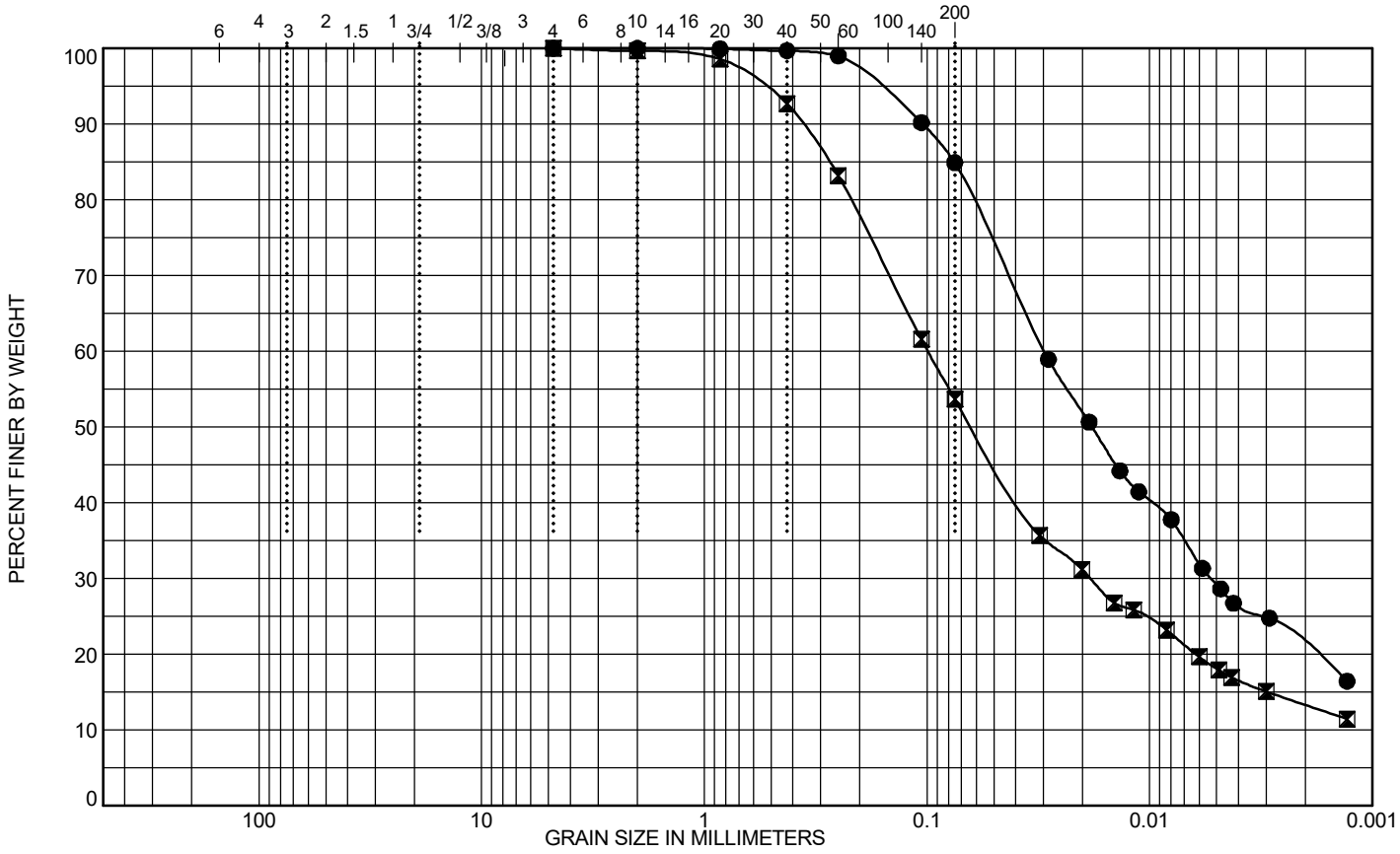
	Boring	S No.	Depth	%Gravel	%Sand	%Silt	%Clay	LL	PI	MC(%)	Classification
●	17BH-01		8.0-10.0			81.0		31	13	24.4	LEAN CLAY with SAND(CL)
⊠	17BH-02		6.0-8.0			50.1		22	6	15.5	SANDY SILTY CLAY(CL-ML)
▲	17BH-03		2.0-4.0			11.1				6.8	
★	17BH-03		10.0-12.0			50.9		22	5	19.6	SANDY SILTY CLAY(CL-ML)
⊙	17BH-04		10.0-12.0			54.6		49	32	21.8	SANDY LEAN CLAY(CL)

GRAIN SIZE DISTRIBUTION (#200 WASH)

T.O 20 - South Park, 4-mile Run Trail

Arlington, Virginia

Project Number: 17-0043 (HDR Project# 10055101)



	D10	D30	D60	D100
●		0.005	0.03	4.76
⊠		0.018	0.099	4.76

Test Method: ASTM D422

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Tested By: EM, JW Date: 8/28/2017

	Boring	S No.	Depth	%Gravel	%Sand	%Silt	%Clay	LL	PI	MC(%)	Classification
●	17BH-01		12.0-14.0	0.0	15.1	55.7	29.2	31	12	21.3	LEAN CLAY with SAND(CL)
⊠	17BH-03		14.0-16.0	0.0	46.4	35.6	18.1	22	5	18.5	SANDY SILTY CLAY(CL-ML)

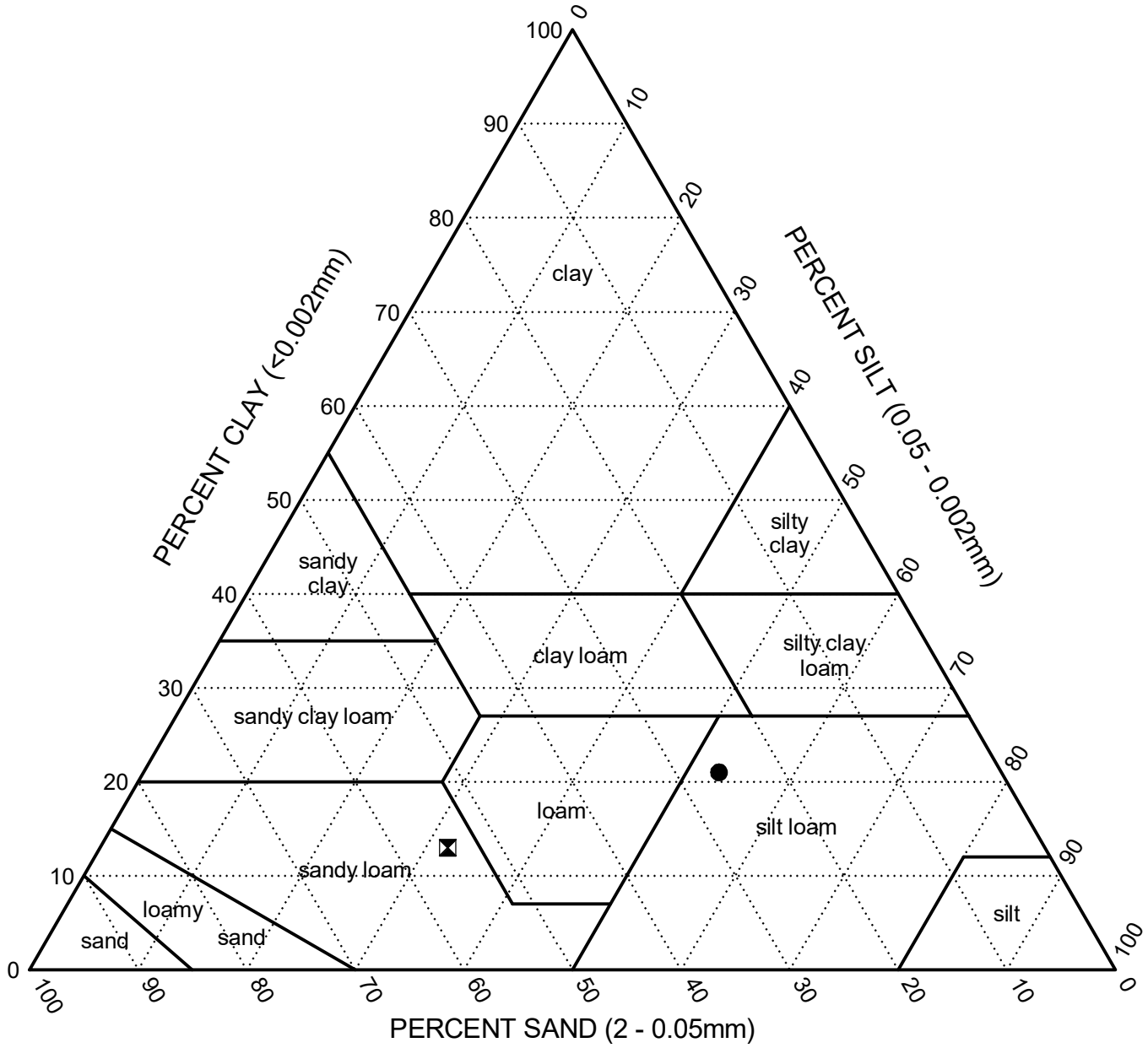
GRAIN SIZE DISTRIBUTION

T.O 20 - South Park, 4-mile Run Trail

Arlington, Virginia

Project Number: 17-0043 (HDR Project# 10055101)

Fractions normalized to 100% passing
the 2mm (#10) sieve



Test Method: ASTM D422

	Boring	Depth	Sand (%)	Silt (%)	Clay (%)	MC(%)	USDA Classification	Tested By	Date
●	17BH-01	12.0	26.0	53.1	20.9	21.3	SILT LOAM	EM	8/28/2017
⧓	17BH-03	14.0	54.5	32.1	13.4	18.5	SANDY LOAM	EM	8/28/2017

USDA Textural Classification Chart

Project: T.O 20 - South Park, 4-mile Run Trail

Location: Arlington, Virginia

Project Number: 17-0043 (HDR Project# 10055101)

TLB GRAIN SIZE LANDSCAPE USDA 17-0043.LAB.GPJ 8/31/17

APPENDIX D

CALCULATIONS

Slope Stability
Trail Pavement Analysis

Subsurface Stratigraphy and Geotechnical Parameters For Global Stability Analysis (Geostudio Slope/w)

Station: 11+50
Test Borings used for Evaluations: 17BH-01, 02, 03, 04 (Composite Stratigraphy)

Interpreted Stratigraphy and Geotechnical Parameters for Upper Cut Slope Stability Analysis

Soil Layer	Elevation Range (ft)	Unit Weight (pcf)	Long-Termed (Drained)		Short-term (Undrained)	
			Friction Angle (degrees)	Cohesion (psf)	Friction Angle (degrees)	Cohesion (psf)
Stratum 1: Existing Fill	26 to 20	125	34	0	34	0
Stratum 2: Very Loose Sand	20 to 18	115	30	0	30	0
Stratum 3: Soft Clay	18 to 3	110	26	0	0	500
Stratum 4: Loose Sand	3 to 0	120	30	0	30	0

Interpreted Stratigraphy and Geotechnical Parameters for Lower Fill Slope Stability Analysis

Soil Layer	Elevation Range (ft)	Unit Weight (pcf)	Long-Termed (Drained)		Short-term (Undrained)	
			Friction Angle (degrees)	Cohesion (psf)	Friction Angle (degrees)	Cohesion (psf)
New Fill	--	120	32	0	32	0
Stratum 1: Soft Clay	13 to 3	110	26	0	0	500
Stratum 2: Loose Sand	3 to -2	120	30	0	30	0

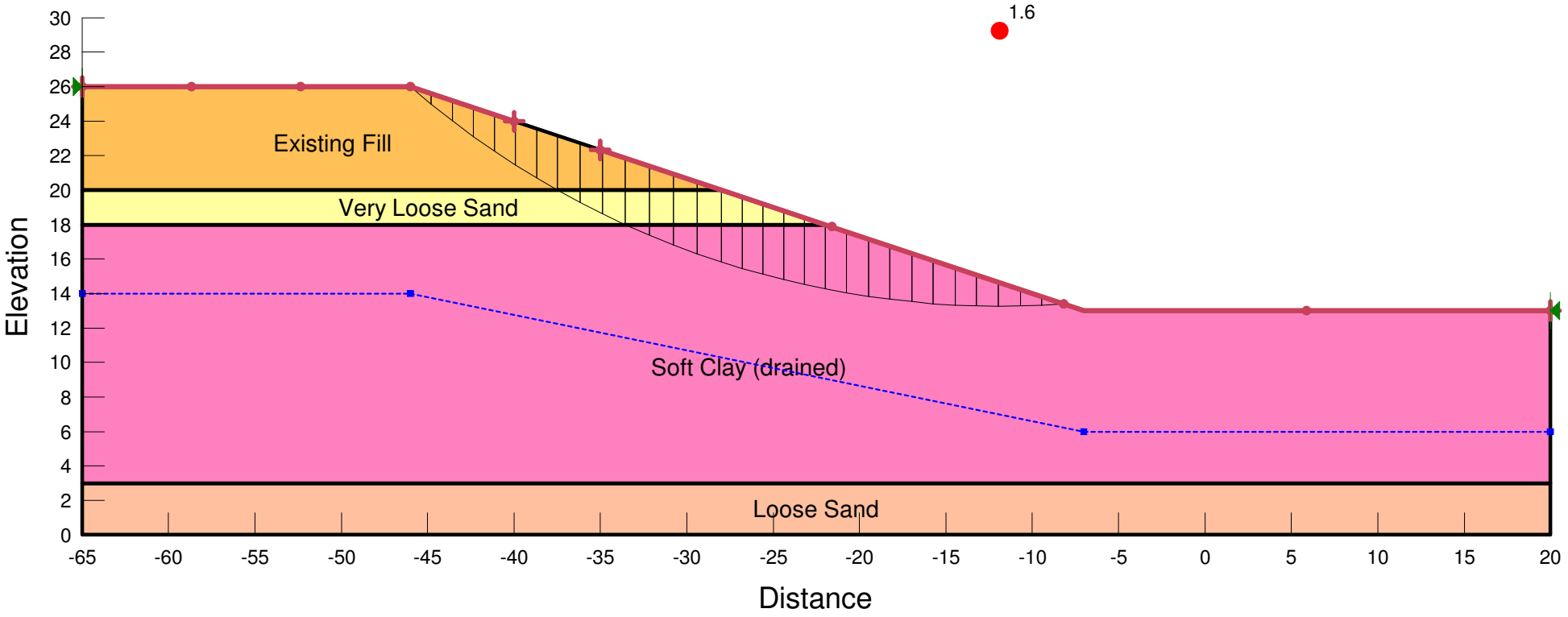
Subsurface Stratigraphy and Geotechnical Parameters For Global Stability Analysis (Geostudio Slope/w)

Station: 21+50
Test Borings used for Evaluations: 17BH-04

Interpreted Stratigraphy and Geotechnical Parameters for Upper Cut Slope Stability Analysis

Soil Layer	Elevation Range (ft)	Unit Weight (pcf)	Long-Termed (Drained)		Short-term (Undrained)	
			Friction Angle (degrees)	Cohesion (psf)	Friction Angle (degrees)	Cohesion (psf)
Stratum 1: Firm Clay	13.5 to 10	110	28	0	0	750
Stratum 2: Medium Dense Sand	10 to8	125	32	0	32	0
Stratum 3: Very Stiff Clay	8 to -4	125	28	0	0	1,250
Rip Rap		110	48	0	48	0

4 Mile Run Trail (11+50)
3:1 cut slope (drained)
FS: 1.6



Name: Existing Fill Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 34 ° Phi-B: 0 ° Piezometric Line: 1
Name: Very Loose Sand Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Soft Clay (drained) Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion': 0 psf Phi': 26 ° Phi-B: 0 ° Piezometric Line: 1
Name: Loose Sand Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1

3:1 cut slope (drained)

File Information

File Version: 8.15
Title: 4 Mile Run Trail (11+50)
Created By: Heiter, Kohltan
Last Edited By: Wallen, Joe
Revision Number: 198
Date: 9/19/2017
Time: 4:42:36 PM
Tool Version: 8.15.4.11512
File Name: slopestability_3-1_cutslope.gsz
Directory: J:\GEOTECH\Projects\Four-Mile Run Trail and Park, Arlington, VA\Analysis\Slope Stability\
Last Solved Date: 9/19/2017
Last Solved Time: 4:42:38 PM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

3:1 cut slope (drained)

Kind: SLOPE/W
Method: Spencer
Settings
- PWP Conditions Source: Piezometric Line
- Apply Phreatic Correction: No
- Use Staged Rapid Drawdown: No

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Resisting Side Maximum Convex Angle: 1 °
- Driving Side Maximum Convex Angle: 5 °
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Linear Search
Must Obtain Factor of Safety at Lambda: 0.2
Lambda
Lambda 1: -1
Lambda 2: -0.8
Lambda 3: -0.6
Lambda 4: -0.4
Lambda 5: -0.2
Lambda 6: 0
Lambda 7: 0.2
Lambda 8: 0.4
Lambda 9: 0.6
Lambda 10: 0.8
Lambda 11: 1

Materials

Existing Fill

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Very Loose Sand

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Soft Clay (drained)

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 26 °
Phi-B: 0 °

Pore Water Pressure
Piezometric Line: 1

Loose Sand

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-65, 26) ft
Left-Zone Right Coordinate: (-40, 24) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (-35, 22.333333) ft
Right-Zone Right Coordinate: (20, 13) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (-65, 26) ft
Right Coordinate: (20, 13) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-65	14
Coordinate 2	-46	14
Coordinate 3	-7	6
Coordinate 4	20	6

Points

	X (ft)	Y (ft)
Point 1	-65	0
Point 2	-65	26
Point 3	-46	26

Point 4	-7	13
Point 5	20	13
Point 6	-65	18
Point 7	-22	18
Point 8	-65	20
Point 9	-28	20
Point 10	20	0
Point 11	-65	3
Point 12	20	3

Regions

	Material	Points	Area (ft²)
Region 1	Existing Fill	2,3,9,8	168
Region 2	Very Loose Sand	8,6,7,9	80
Region 3	Soft Clay (drained)	6,7,4,5,12,11	1,102.5
Region 4	Loose Sand	11,1,10,12	255

Current Slip Surface

Slip Surface: 87
F of S: 1.6
Volume: 105.7087 ft³
Weight: 12,187.185 lbs
Resisting Moment: 322,503.17 lbs-ft
Activating Moment: 196,940.19 lbs-ft
Resisting Force: 5,751.5217 lbs
Activating Force: 3,512.5826 lbs
F of S Rank (Analysis): 2 of 125 slip surfaces
F of S Rank (Query): 2 of 125 slip surfaces
Exit: (-8.1927754, 13.397592) ft
Entry: (-46.006584, 26) ft
Radius: 52.245872 ft
Center: (-11.829696, 65.516724) ft

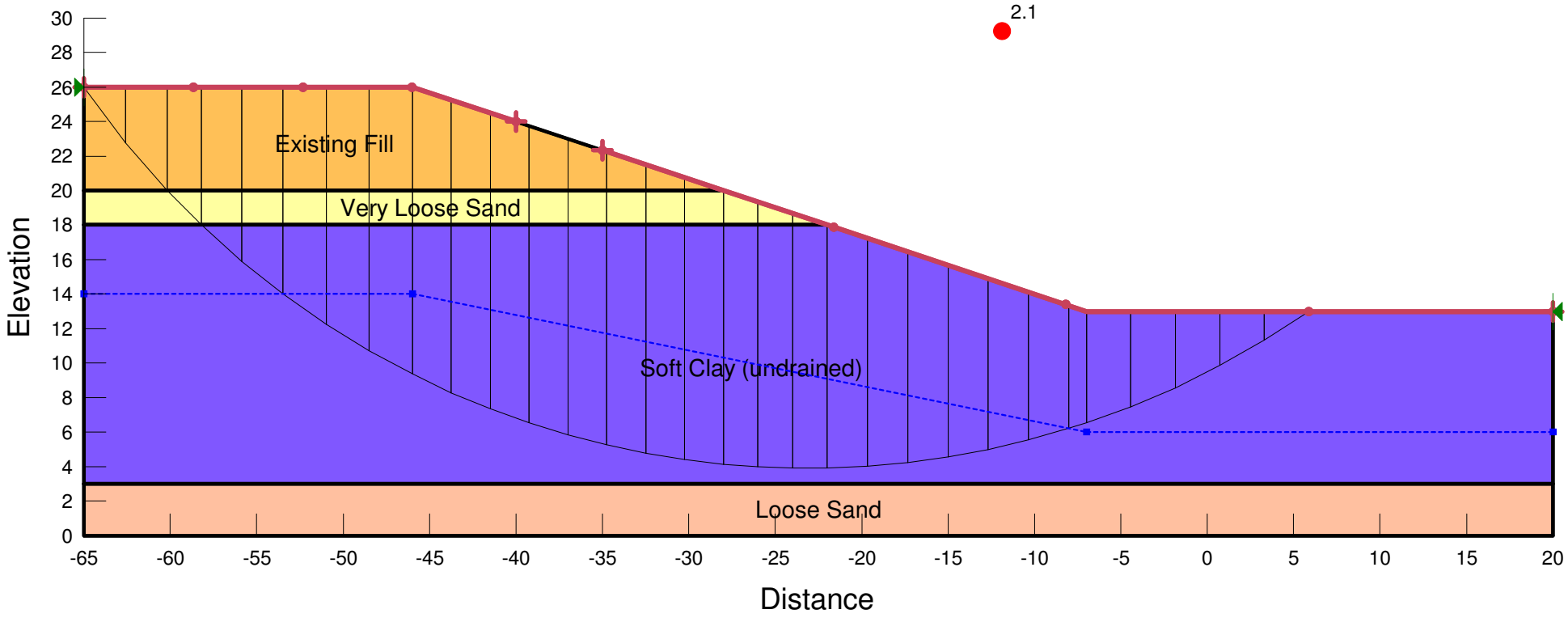
Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)

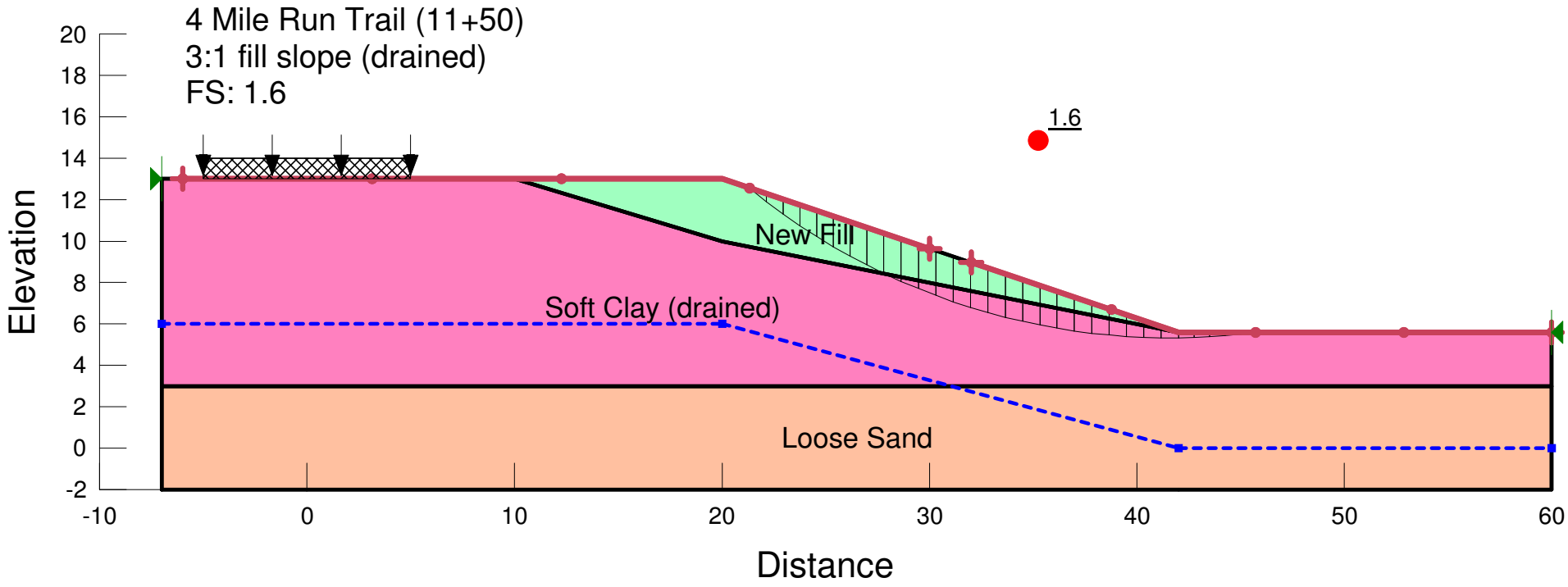
Slice 1	-46.003292	25.997154	-748.62238	0.23774717	0.16036249	0
Slice 2	-45.391318	25.484016	-724.39371	26.486085	17.86509	0
Slice 3	-44.173955	24.493813	-678.18732	77.817479	52.488552	0
Slice 4	-42.956592	23.562308	-635.64363	126.33809	85.216119	0
Slice 5	-41.739229	22.685663	-596.52323	171.97819	116.00076	0
Slice 6	-40.521865	21.860567	-560.61953	214.67584	144.80068	0
Slice 7	-39.304502	21.084146	-527.75308	254.37394	171.57739	0
Slice 8	-38.087139	20.353884	-497.76701	291.0181	196.29419	0
Slice 9	-36.823793	19.643307	-469.59778	326.43194	188.46557	0
Slice 10	-35.514464	18.953612	-443.32024	352.97971	203.79293	0
Slice 11	-34.205135	18.310305	-419.93732	375.84232	216.99266	0
Slice 12	-32.856662	17.694936	-398.79875	396.47789	193.37519	0
Slice 13	-31.469044	17.108393	-379.95995	409.3959	199.67572	0
Slice 14	-30.081427	16.568209	-364.01396	418.02692	203.88535	0
Slice 15	-28.693809	16.072862	-350.86586	422.30602	205.97241	0
Slice 16	-27.4	15.648882	-340.97024	424.26756	206.92912	0
Slice 17	-26.2	15.289878	-333.92841	424.49425	207.03968	0
Slice 18	-25	14.961904	-328.82284	421.39695	205.52902	0
Slice 19	-23.8	14.664359	-325.61602	414.90767	202.36399	0
Slice 20	-22.6	14.396711	-324.27479	404.95088	197.50774	0
Slice 21	-21.372399	14.153698	-324.82403	392.07761	191.22903	0
Slice 22	-20.117197	13.936259	-327.32242	376.05513	183.41434	0
Slice 23	-18.861994	13.750164	-331.77669	355.98881	173.62734	0
Slice 24	-17.606792	13.595076	-338.16581	331.74951	161.80505	0

Slice 25	-16.35159	13.470718	-346.47245	303.19388	147.87754	0
Slice 26	-15.096388	13.37687	-356.6829	270.16281	131.76721	0
Slice 27	-13.841185	13.313366	-368.78687	232.47962	113.38788	0
Slice 28	-12.585983	13.280097	-382.77747	189.94791	92.643788	0
Slice 29	-11.330781	13.277004	-398.65108	142.34924	69.428363	0
Slice 30	-10.075579	13.304083	-416.40737	89.440213	43.622907	0
Slice 31	-8.8203765	13.36138	-436.04928	30.949268	15.094967	0

4 Mile Run Trail (11+50)
3:1 cut slope (undrained)
FS: 2.1



Name: Existing Fill Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 34 ° Phi-B: 0 ° Piezometric Line: 1
Name: Soft Clay (undrained) Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion': 500 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1
Name: Very Loose Sand Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Loose Sand Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1



Name: Soft Clay (drained) Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion': 0 psf Phi': 26 ° Phi-B: 0 ° Piezometric Line: 1
Name: Loose Sand Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: New Fill Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 32 ° Phi-B: 0 ° Piezometric Line: 1

3:1 fill slope (drained)

File Information

File Version: 8.15
Title: 4 Mile Run Trail (11+50)
Created By: Heiter, Kohltan
Last Edited By: Wallen, Joe
Revision Number: 193
Date: 9/19/2017
Time: 4:46:06 PM
Tool Version: 8.15.4.11512
File Name: slopestability_3-1_fillslope_withfill.gsz
Directory: J:\GEOTECH\Projects\Four-Mile Run Trail and Park, Arlington, VA\Analysis\Slope Stability\
Last Solved Date: 9/19/2017
Last Solved Time: 4:46:08 PM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

3:1 fill slope (drained)

Kind: SLOPE/W
Method: Spencer
Settings
- PWP Conditions Source: Piezometric Line
- Apply Phreatic Correction: No
- Use Staged Rapid Drawdown: No

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Resisting Side Maximum Convex Angle: 1 °
- Driving Side Maximum Convex Angle: 5 °
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Linear Search
Must Obtain Factor of Safety at Lambda: 0.2
Lambda
Lambda 1: -1
Lambda 2: -0.8
Lambda 3: -0.6
Lambda 4: -0.4
Lambda 5: -0.2
Lambda 6: 0
Lambda 7: 0.2
Lambda 8: 0.4
Lambda 9: 0.6
Lambda 10: 0.8
Lambda 11: 1

Materials

Soft Clay (drained)

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 26 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Loose Sand

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

New Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-6, 13) ft
Left-Zone Right Coordinate: (30, 9.636364) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (32, 8.963636) ft
Right-Zone Right Coordinate: (60, 5.6) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (-7, 13) ft
Right Coordinate: (60, 5.6) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-7	6
Coordinate 2	20	6
Coordinate 3	42	0
Coordinate 4	60	0

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 100 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	-5	14
	5	14

Points

	X (ft)	Y (ft)
Point 1	-7	-2
Point 2	0	-2
Point 3	-7	13
Point 4	20	13
Point 5	42	-2
Point 6	42	5.6
Point 7	60	5.6
Point 8	60	-2
Point 9	60	3
Point 10	-7	3
Point 11	10	13
Point 12	20	10

Regions

	Material	Points	Area (ft²)
Region 1	Loose Sand	1,2,5,8,9,10	335
Region 2	Soft Clay (drained)	3,10,9,7,6,12,11	407.4
Region 3	New Fill	11,4,6,12	48

Current Slip Surface

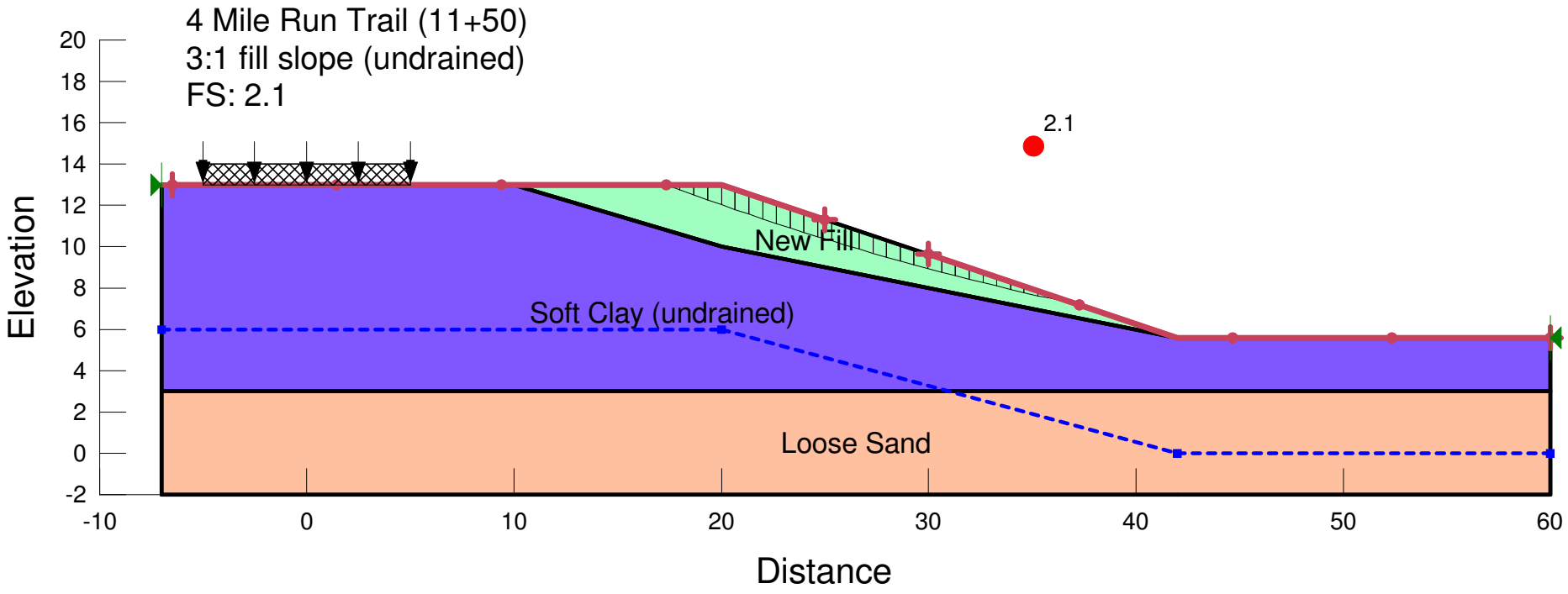
Slip Surface: 87
F of S: 1.6
Volume: 31.873305 ft³
Weight: 3,717.6982 lbs
Resisting Moment: 59,170.364 lbs-ft
Activating Moment: 35,948.455 lbs-ft
Resisting Force: 1,739.0706 lbs
Activating Force: 1,056.6651 lbs
F of S Rank (Analysis): 1 of 125 slip surfaces
F of S Rank (Query): 1 of 125 slip surfaces
Exit: (45.724726, 5.6) ft

Entry: (21.339182, 12.549548) ft
Radius: 31.854337 ft
Center: (41.541108, 37.178412) ft

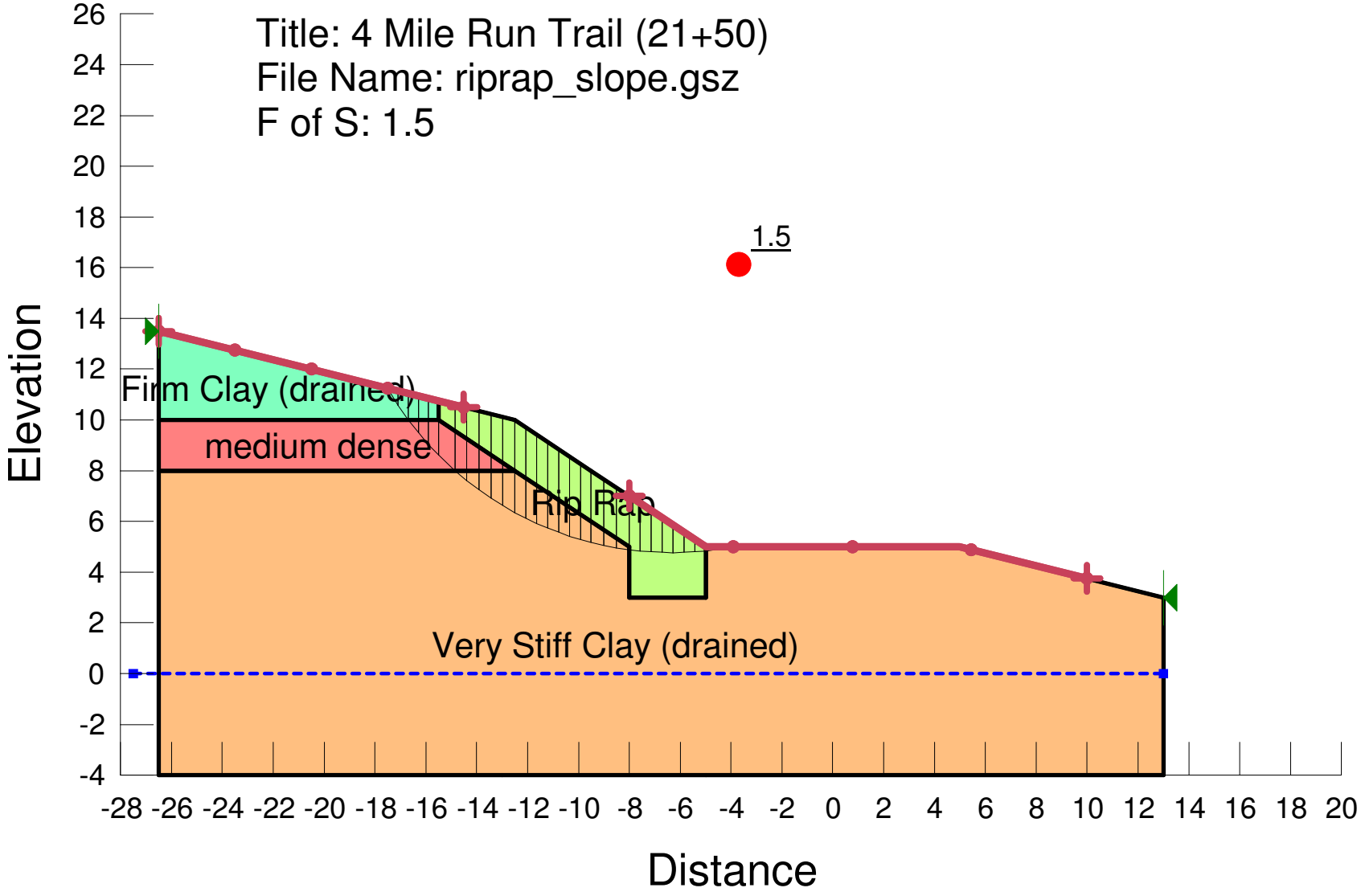
Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	21.743044	12.229071	-418.35747	15.54556	9.7139443	0
Slice 2	22.550769	11.608651	-393.38924	46.019728	28.756317	0
Slice 3	23.358493	11.027899	-370.89636	74.40509	46.49346	0
Slice 4	24.166217	10.484223	-350.71696	100.66122	62.900114	0
Slice 5	24.973942	9.9753946	-332.71207	124.75124	77.953224	0
Slice 6	25.781666	9.4994893	-316.76157	146.63989	91.630773	0
Slice 7	26.58939	9.0548331	-302.76103	166.29216	103.91087	0
Slice 8	27.397114	8.6399636	-290.61916	183.67209	114.77106	0
Slice 9	28.218595	8.247494	-280.10917	200.27202	97.679189	0
Slice 10	29.053832	7.8772071	-271.21747	211.24826	103.03266	0
Slice 11	29.889068	7.5350758	-264.08269	219.7718	107.18987	0
Slice 12	30.724305	7.2201345	-258.64456	225.80866	110.13424	0
Slice 13	31.559542	6.9315329	-254.85003	229.31989	111.84679	0
Slice 14	32.394778	6.6685228	-252.65242	230.26097	112.30578	0
Slice 15	33.230015	6.430447	-252.0107	228.58126	111.48653	0
Slice 16	34.065252	6.2167298	-252.88895	224.22336	109.36104	0
Slice 17	34.900488	6.0268694	-255.25587	217.12244	105.89769	0
Slice 18	35.735725	5.8604316	-259.08436	207.20549	101.06087	0
Slice 19	36.570962	5.7170444	-264.35121	194.3904	94.810532	0
Slice 20	37.406198	5.5963935	-271.0368	178.58499	87.101718	0
	38.241435	5.498219	-279.12493	159.68589	77.884012	0

Slice 21						
Slice 22	39.076672	5.4223124	-288.60256	137.57722	67.100894	0
Slice 23	39.911908	5.368514	-299.45975	112.12907	54.689001	0
Slice 24	40.747145	5.3367117	-311.6895	83.195718	40.577263	0
Slice 25	41.582382	5.3268397	-325.28769	50.613586	24.685895	0
Slice 26	42.372473	5.337106	-333.03541	32.295251	15.751447	0
Slice 27	43.117418	5.3652868	-334.79389	29.289471	14.28543	0
Slice 28	43.862363	5.4109591	-337.64385	23.970212	11.691054	0
Slice 29	44.607308	5.4741986	-341.58999	16.213799	7.907998	0
Slice 30	45.352254	5.5551107	-346.63891	5.8827736	2.8692204	0



Name: Soft Clay (undrained) Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion': 500 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1
Name: Loose Sand Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: New Fill Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 32 ° Phi-B: 0 ° Piezometric Line: 1



Name: Firm Clay (drained) Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion': 0 psf Phi': 28 ° Phi-B: 0 ° Piezometric Line: 1
Name: medium dense Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 32 ° Phi-B: 0 ° Piezometric Line: 1
Name: Very Stiff Clay (drained) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 28 ° Phi-B: 0 ° Piezometric Line: 1
Name: Rip Rap Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion': 0 psf Phi': 48 ° Phi-B: 0 ° Piezometric Line: 1

1.5:1 rip rap slope (drained)

File Information

File Version: 8.15
Title: 4 Mile Run Trail (21+50)
Created By: Heiter, Kohltan
Last Edited By: Wallen, Joe
Revision Number: 231
Date: 9/19/2017
Time: 4:34:04 PM
Tool Version: 8.15.4.11512
File Name: riprap_slope.gsz
Directory: J:\GEOTECH\Projects\Four-Mile Run Trail and Park, Arlington, VA\Analysis\Slope Stability\
Last Solved Date: 9/19/2017
Last Solved Time: 4:34:08 PM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

1.5:1 rip rap slope (drained)

Kind: SLOPE/W
Method: Spencer
Settings
- PWP Conditions Source: Piezometric Line
- Apply Phreatic Correction: No
- Use Staged Rapid Drawdown: No

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Resisting Side Maximum Convex Angle: 1 °
- Driving Side Maximum Convex Angle: 5 °
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Linear Search
Must Obtain Factor of Safety at Lambda: 0.2
Lambda
Lambda 1: -1
Lambda 2: -0.8
Lambda 3: -0.6
Lambda 4: -0.4
Lambda 5: -0.2
Lambda 6: 0
Lambda 7: 0.2
Lambda 8: 0.4
Lambda 9: 0.6
Lambda 10: 0.8
Lambda 11: 1

Materials

Firm Clay (drained)

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 28 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

medium dense

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Very Stiff Clay (drained)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 28 °
Phi-B: 0 °

Pore Water Pressure
Piezometric Line: 1

Rip Rap

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 48 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-26.5, 13.5) ft
Left-Zone Right Coordinate: (-14.5, 10.5) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (-8, 7) ft
Right-Zone Right Coordinate: (10, 3.75) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (-26.5, 13.5) ft
Right Coordinate: (13, 3) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-27.5	0
Coordinate 2	13	0

Points

	X (ft)	Y (ft)
Point 1	-26.5	13.5
Point 2	-12.5	10
Point 3	-5	5
Point 4	13	3
Point 5	-26.5	10

Point 6	-26.5	-4
Point 7	-13	-4
Point 8	-5	-4
Point 9	13	-4
Point 10	-26.5	8
Point 11	-9.5	8
Point 12	-15.5	10.75
Point 13	-8	3
Point 14	-5	3
Point 15	-12.5	8
Point 16	-15.5	10
Point 17	5	5
Point 18	-8	5

Regions

	Material	Points	Area (ft^2)
Region 1	Firm Clay (drained)	1,12,16,5	23.375
Region 2	medium dense	5,10,15,16	25
Region 3	Rip Rap	16,15,18,13,14,3,11,2,12	22.125
Region 4	Very Stiff Clay (drained)	6,7,8,9,4,17,3,14,13,18,15,10	390.25

Current Slip Surface

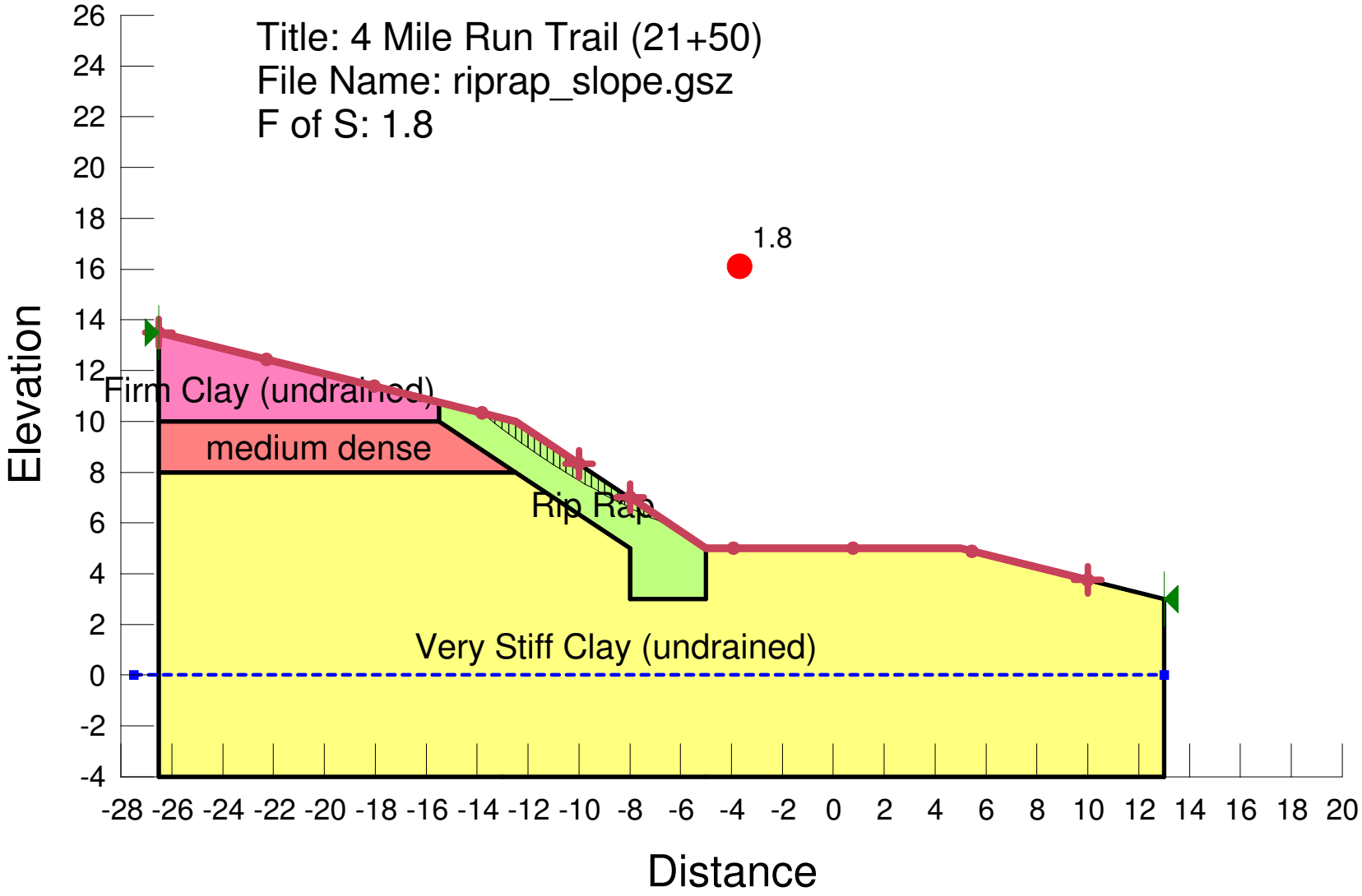
Slip Surface: 83
F of S: 1.5
Volume: 28.749072 ft^3
Weight: 3,320.2831 lbs
Resisting Moment: 26,402.598 lbs-ft
Activating Moment: 17,445.758 lbs-ft
Resisting Force: 1,852.7908 lbs
Activating Force: 1,224.3917 lbs
F of S Rank (Analysis): 1 of 125 slip surfaces
F of S Rank (Query): 1 of 125 slip surfaces

Exit: (-3.9156929, 5) ft
Entry: (-17.5, 11.25) ft
Radius: 12.867334 ft
Center: (-6.3307041, 17.638671) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-17.296341	10.917718	-681.26563	14.821934	7.8809619	0
Slice 2	-16.889023	10.292718	-642.26563	45.537002	24.212453	0
Slice 3	-16.487804	9.7457661	-608.1358	75.0278	46.882573	0
Slice 4	-16.092682	9.2613182	-577.90625	107.01715	66.871736	0
Slice 5	-15.697561	8.8212333	-550.44496	138.24589	86.385619	0
Slice 6	-15.17752	8.3056812	-518.27451	175.45806	109.63836	0
Slice 7	-14.619536	7.8015623	-486.81749	216.87051	115.31209	0
Slice 8	-14.148528	7.4229004	-463.18898	246.35368	130.98857	0
Slice 9	-13.67752	7.0788286	-441.71891	274.03234	145.70558	0
Slice 10	-13.206512	6.7660491	-422.20146	299.90543	159.46255	0
Slice 11	-12.735504	6.4819205	-404.47184	323.97104	172.25846	0
Slice 12	-12.285714	6.2348252	-389.05309	337.47921	179.44088	0
Slice 13	-11.857143	6.0209926	-375.70994	339.8576	180.70549	0
Slice 14	-11.428571	5.8265771	-363.57841	339.80539	180.67773	0
Slice 15	-11	5.6506321	-352.59945	337.29418	179.34249	0
Slice 16	-10.571429	5.4923537	-342.72287	332.28228	176.67762	0
Slice 17	-10.142857	5.3510579	-333.90601	324.71408	172.65354	0
Slice 18	-9.7142857	5.226164	-326.11264	314.51902	167.23273	0
Slice 19	-9.25	5.1095009	-318.83286	300.32161	159.68383	0
Slice 20	-8.75	5.0033831	-312.21111	281.40906	149.62785	0

Slice 21	-8.25	4.9177959	-306.87046	258.44008	137.41503	0
Slice 22	-7.7857143	4.8556856	-302.99478	264.66967	293.94545	0
Slice 23	-7.3571429	4.8141439	-300.40258	243.6506	270.60141	0
Slice 24	-6.9285714	4.7870244	-298.71032	218.2901	242.43572	0
Slice 25	-6.5	4.7742357	-297.91231	187.976	208.7685	0
Slice 26	-6.0714286	4.775735	-298.00586	151.93962	168.74604	0
Slice 27	-5.6428571	4.7915273	-298.99131	109.20454	121.28393	0
Slice 28	-5.2142857	4.8216656	-300.87194	58.514324	64.986741	0
Slice 29	-4.7289232	4.874348	-304.15931	20.602702	10.954651	0
Slice 30	-4.1867697	4.9541826	-309.14099	7.8516929	4.1748192	0



Name: Firm Clay (undrained) Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion': 750 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1
Name: medium dense Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 32 ° Phi-B: 0 ° Piezometric Line: 1
Name: Very Stiff Clay (undrained) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 1,250 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1
Name: Rip Rap Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion': 0 psf Phi': 48 ° Phi-B: 0 ° Piezometric Line: 1

Project:	4 Mile Run Trail
Date:	8/23/2017
Calculated by:	KDH
Reviewed and QC'ed by:	ALZ

Highway Classification	Farm to Market Secondary Route		
Urban or Rural	Rural		
# of Lanes Each Direction	1		
Current ADT =	1,100	VPD in year	2017
Growth =	0.50%	per year	
Years Before Open to Traffic =	0	years	
End of Construction Traffic =	1,100	VPD in year	2017

Vehicle Types	% of Total Traffic	ESAL Factor	Vehicles Per Day	Equivalent ESALs (per day)
Cars/Passenger Vehicles	100%	0.0002	1100	0.2
Single Unit Trucks	0%	0.46	0	0.0
Tractor Trailer Trucks	0%	2.00	0	0.0

Design Year	Year	ESALs/Year	Calculated ADT	Cumulative ESALs
1	2017	80	1,100	80
2	2018	81	1106	161
3	2019	81	1111	242
4	2020	82	1117	324
5	2021	82	1122	406
6	2022	82	1128	488
7	2023	83	1133	571
8	2024	83	1139	654
9	2025	84	1145	737
10	2026	84	1151	821
11	2027	84	1156	906
12	2028	85	1162	991
13	2029	85	1168	1,076
14	2030	86	1174	1,161
15	2031	86	1180	1,248
16	2032	87	1185	1,334
17	2033	87	1191	1,421
18	2034	87	1197	1,508
19	2035	88	1203	1,596
20	2036	88	1209	1,685
21	2037	89	1215	1,773
22	2038	89	1221	1,863
23	2039	90	1228	1,952
24	2040	90	1234	2,042
25	2041	91	1240	2,133
26	2042	91	1246	2,224
27	2043	91	1252	2,315
28	2044	92	1259	2,407
29	2045	92	1265	2,499
30	2046	93	1271	2,592

	ESALS Summation	ESALS Growth Equation Based	Growth Factor	ESALS Growth Factor Based			
Cumulative Traffic (both directions):	1,685	1,685	20.98	1,685	**for**	20	**year analysis period**

Growth Factor Determined from Table D.20 AASHTO Guide for Design of Pavement Structures, 1993 referenced equation.

Directional Distribution =	100%	Assume 50% unless specific information is available - VDOT MOI, Chapter 6, VI-43 (July 2011)
Lane Distribution =	100%	VDOT MOI, Chapter 6, VI-42 (July 2011)

Initial Performance Period Design ESALs =	**1,685**	**ESALs for a**	**20**	**year analysis period**

Project:	4 Mile Run Trail
Date:	8/23/2017
Calculated by:	KDH
Reviewed and QC'ed by:	ALZ

Reference Documents:

[1]Virginia Department of Transportation, Manual of Instructions (MOI), Chapter 6, "Pavement Evaluation and Design," July 2011

[2]AASHTO Design Guide for Design of Pavement Structures, 1993

Controlling Equation: $\log_{10}W_{18} = Z_R S_o + 9.36\log_{10}(SN+1) - 0.20 + \log_{10}[\Delta PSI_{TR}/(4.2\text{-}1.5)]/[0.40+(1{,}094/(SN+1)^{5.19}]+2.32\log_{10}M_r\text{-}8.07$ (AASHTO Equation 1.2.1)

W_{18} =	1,685	ESALS (predicted number of 18-kip equivalent single axle load applications), see Design ESAL Calculation Sheet
Z_R =	-0.674	standard normal deviate (Table 4.1, AASHTO)
Standard Deviation, S_o =	0.49	combined standard error of the traffic prediction and performance prediction, VDOT MOI, Chapter 6, VI-43 (July 2011)
Reliability, R =	75%	VDOT MOI, Chapter 6, VI-43 (July 2011)
Initial Serviceability, p_o=	4.0	VDOT MOI, Chapter 6, VI-43 (July 2011)
Terminal Serviceability, p_t =	2.5	VDOT MOI, Chapter 6, VI-43 (July 2011)
Design Serviceability Loss, ΔPSI =	1.5	(p_o-p_t)
Serviceability Loss Due to Swell ΔPSI_{SW} =	0.0	(AASHTO Appendix G, Figure G.4)
Serviceability Loss Due to Frost, ΔPSI_{FH} =	0.0	(AASHTO Appendix G, Figure G.8)
Serviceability Loss Due to Traffic ΔPSI_{TR} =	1.5	($\Delta PSI_{TR} = \Delta PSI - \Delta PSI_{FH} - \Delta PSI_{SW}$, AASHTO)

VDOT Correlation Applied:	**Design Mr=1,500 x CBR (fine-grained, CBR<10)**	
Average Laboratory CBR=	3.0	
Design CBR=	2.0	
USE - Design Resilient Modulus, M_r =	**3,015**	**psi**
Required Structural Number, SN =	**1.6**	**Use CTRL + Shift + F to solve using Macro**
	1.60	
$\log_{10}W_{18}$ =	3.23	
$Z_R S_o$ =	-0.33	
$9.36\log_{10}(SN+1)$ =	3.9	
$\log_{10}[\Delta PSI/(4.2\text{-}1.5)]$=	-0.26	
$0.40 + (1{,}094/(SN+1)^{5.19})$ =	8.4	
$2.32\log_{10}M_r$ =	8.0	
Solved Equation Set = 0:	**0.00**	**Use CTRL + Shift + F to solve using Macro**

Project: 4 Mile Run Trail
Date: 8/23/2017
Calculated by: KDH
Reviewed and QC'ed by: ALZ

Cumulative ESALS = 1,685

Local

Layer	Layer Type	Binder Specification	Layer Structural Coeff.	Min. Lift Thickness	Max. Lift Thickness	Selected Thickness	Calculated Layer Structural Number, SN_i
SM-9.5	Surface Mix	A	0.44	1.25	1.50	2.0	0.9
VDOT 21a or 21b	Graded Aggregate Base		0.12	N/A	N/A	6.0	0.7
					Total Thickness:	8.0	
						Proposed Pavement SN:	1.6
						Required SN	1.6

J:\GEOTECH\Projects\Four-Mile Run Trail and Park, Arlington, VA\Analysis\[VDOT Pavement Design Spreadsheet, 10-2016.xlsm]Solution - Flexible

APPENDIX E

ENVIRONMENTAL ASSESSMENT

Technical Memorandum

To:	Brandon Nevers, PE - Kittelson & Associates, Inc.		
From:	Vincent M. Carbone - HDR Thomas Wallen, PE - HDR Aaron Zdinak, PE - HDR	**Project:**	Potomac Yards
Re:	Environmental Assessment for Four Mile Run Trail		
Date:	Tuesday, November 21, 2017	**Project No:**	10055101

1.0 INTRODUCTION

The purpose of the memorandum is to summarize the results of the environmental assessment performed in conjunction with the geotechnical subsurface exploration. The primary objective is to appropriately characterize the nature and extent of potential contamination to provide recommendations for site development that account encountered environmental conditions. The environmental assessment followed HDR's earlier environmental screening, which consisted of reviewing existing information on the planned Trail and Park project site. Based on the results of the review, preliminary conclusions with respect to the potential level of contamination and conceptual management techniques were determined. Details of the environmental screening are contained in Section 2.0.

The environmental assessment included physical sampling and testing of representative on-site soils to environmentally characterize them and compare the results to the Virginia Department of Environmental Quality (Virginia DEQ) threshold values for unrestricted or restricted reuse. The results of the environmental assessment were also used to provide recommendations for the appropriate controls to put in place that would lower the risk of exposure to reasonable levels during the life of the Trail. Details of the environmental assessment are contained in Section 3.0 through 7.0.

2.0 ENVIRONEMNTAL SCREENING

To determine potential impacts to soil from historical operations HDR reviewed the following documents and readily available websites from Virginia DEQ:

- "Extent of Contamination Study Potomac Yard, Alexandria, Virginia," dated May 24, 1995.
- Figures identified in "Extent of Contamination Study Potomac Yard, Alexandria, Virginia, Volume II" dated February 22, 1995.
- Virginia DEQ GIS http://www.deq.virginia.gov/mapper_ext/?service=public/wimby. This site includes facilities that are currently in the VRP, have registered tanks or petroleum releases.

- USEPA website for the Administrative Record for Enforcement Removal Activities related to the Potomac Yards: https://cumulis.epa.gov/supercpad/cursites/cadminrecord.cfm?id=0303314&doc=Y&colid=586

The full project site is identified in Figure 1.

Figure 1: Proposed 4 Mile Run Trail and Park Project Site

Upon review of the Virginia DEQ sourced information, no current regulatory issues are currently identified at the project site. However, several parcels proximal to the project site do have record of regulatory issues. The parcels surrounding the project site with identified regulatory records are depicted in Figure 2.

Figure 2: Proximal Parcels with Past Regulatory Records

The nearest facilities not part of the subject parcel are identified west of Route 1.

USEPA has identified an Enforcement Removal Action having occurred as part of the larger Richmond, Fredericksburg &Potomac Railroad Company (RF&P) property beginning in the late 1980's and completing in Spring 1999. The administrative record can be found in the link identified previously and comprises a list of several hundred documents. HDR did not review all documents, however focused on pertinent information provided in:

- "Extent of Contamination Study Potomac Yard, Alexandria, Virginia," dated May 24, 1995.
- Figures identified in "Extent of Contamination Study Potomac Yard, Alexandria, Virginia, Volume II" dated February 22, 1995.

The project was part of the North Tail or North Yards in the aforementioned reports.

Based on the review of documents discussed above, HDR provided the following comments as they pertain to the Trail and Park site (From Tables 1-1 and 6-1 of the source document):

- Metals and semi-volatile compounds, TPH, impact soil and/or groundwater: Metals impacts were and could still be above threshold values as established by EPA Regional Screening Levels using a Target Cancer Risk (TR) of 1E-06 with a Target Hazard Quotient (THQ) of 1.0. As stated in the 1995 report, metals concentrations were variable across the site. Since metals often do not readily degrade, concentrations of metals are likely to exceed the unrestricted use standards. See Table 1 (attached) for comparison of Metals and semi-volatile compounds. Areas of free product were identified in the report, and potential areas may still exist.
- Volatile organic compounds, including TCE, were identified in areas of the Potomac Yard in concentrations exceeding threshold values soil, groundwater and surface water. Due to the nature of these types of contaminants, they readily degrade in the environment and are likely to have lower concentrations previously assessed.
- Pesticides were detected in both the Rail Yard and Potomac Greens, while PCBs were only detected in the Rail Yard. These contaminants were also detected in various locations around the site. These contaminates do not readily degrade and HDR cannot rule out that they may be present in soil in similar concentration to when first detected.
- Based on the location of the parcel HDR assumes that groundwater is not being used on the parcel.

3.0 ENVIRONMENTAL ASSESSMENT OBJECTIVE AND SCOPE OF WORK

Based on HDR's completion of the environmental screening identified in Section 1.0, HDR completed an environmental assessment to identify analytes within the likely depths of disturbance on the site that continue to exceed the EPA Regional Screening Levels using a Target Cancer Risk (TR) of 1E-06 with a Target Hazard Quotient (THQ) of 1.0. To achieve this objective, HDR executed the following scope of services:

- Collected environmental samples in concurrence with the geotechnical subsurface exploration in order to identify contaminants at depth intervals approximately equal to the planned depth of excavation and below the planned depth of excavation
- Completed environmental laboratory testing on soil (as detailed in Section 4.0)
- Summarized the results of the environmental laboratory testing and provided recommendations for the reuse or disposal of observed impacted soils.

4.0 SOIL INVESTIGATION

HDR collected composite samples from split spoon sampling and auger cuttings in conjunction with the geotechnical subsurface exploration. Split spoons were decontaminated between each split spoon interval, and augers were decontaminated between each test boring. Auger cuttings were only used to composite the uppermost sample in each boring. Decontamination consisted of Alconox and distilled water. Eight composite samples were collected based on proposed cuts depths and fill heights at the test boring locations. A list of samples collected is provided in Table

2. Details of the geotechnical subsurface exploration are provided in the GER. An As-Drilled Boring Location Plan is provided as Figure 2 in the GER.

Table 2 – Summary of Soil Sampling

Sample ID	Test Boring ID	Approximate Station[1]	Surface El. Test Boring (ft)[1]	Sample Depth (ft bgs)	Proposed Cut Depths / Fill Heights at Boring Location (ft)
17BH-01 0-4'	17BH-01	10+75	26.5	0 – 4	Cut – 11 ft
17BH-01 4-10'				4-10	
17BH-01 10-16'				10-16	
17BH-02 0-4'	17BH-02	11+25	11	0-4	Fill – 2 ft
17BH-03 0-4'	17BH-03	12+00	25.5	0-4	Cut – 4 ft
17BH-03 4-10'				4-10	
17BH-04 0-4'	17BH-04	12+50	18	0-4	Cut – 6 ft
17BH-04 4-10'				4-10	

[1]Boring locations and surface elevations are approximate only. Stations and elevations are based on field measurements from existing site features and correlations from Figure 2 in Appendix A of the GER.

The samples were shipped to Air Water & Soil Laboratories, Inc. in Richmond, VA for analysis. The following tests were conducted on each of the eight composite samples.

- Volatile Organic Compounds (VOC's) - Solids (SW8260B)
- TAL Metals - Solids
- Semi-Volatile Organic Compounds (SVOC's) - Solids (SW8270D)
- Percent Solids (SM18 2540G)

In addition, the lab created a composite sample from the eight composite samples collected from the test borings and performed the following tests.

- PCB's – Solids (SW8082A)
- Percent Solids (SM18 2540G)

The detailed results of the chemical-analytical laboratory tests are attached as Table 3, which includes the EPA Regional Screening Level for Resident Soil.

5.0 ANALYTICAL DATA QUALITY CONTROL PARAMETERS

The purpose of the environmental assessment was to determine the presence or absence as well as the general extent of environmental impacts within the proposed cut area at the Site. Third party data validation by a certified data validation contractor was not required for this investigation.

6.0 CONCLUSIONS

As summarized in Table 4, only seven of the tested analytes exceeded the threshold levels associated with EPA Regional Screening Levels using a Target Cancer Risk (TR) of 1E-06 with a Target Hazard Quotient (THQ) of 1.0.

Table 4–Summary of Analytes Exceeding EPA Regional Screening Level for Resident Soil

Analyte	EPA Regional Screening Resident Soil Threshold (mg/kg)[1]	Lowest Concentration Detected (mg/kg)	Highest Concentration Detected (mg/kg)
Arsenic	0.68	5.99	75.2
Thallium	0.78	<2.5 (DL)	2.88
Benzo (a) pyrene	0.11	<0.0833 (DL)	<0.331 (DL)
Bis (2-chloroethyl) ether	0.23	<0.0833 (DL)	<0.331 (DL)
Dibenzo (a,h) anthracene	0.11	<0.0833 (DL)	<0.331 (DL)
Hexachlorobenzene	0.21	<0.0833 (DL)	<0.331 (DL)
N-Nitroso-di-n-propylamine	0.078	<0.0833 (DL)	<0.331 (DL)

Notes:
[1] Threshold values represent Target Cancer Risk (TR) of 1E-06 with a Target Hazard Quotient (THQ) of 1.0 for purposes of this screening process, June 2017.
DL = Detection Limit as reported by the chemical-analytical laboratory.

The health risk associated with the metals Arsenic and Thallium is considered low as a result of measured concentration levels and the planned landscaping (paved trails, ,topsoil, grass, plantings, etc.), which results in limited potential exposure time during typical trail/park activities. Likewise, the remaining five "above threshold" analytes are related to weathered petroleum products. The concentration of these compounds is low, and they likely exceed the risk assessment criteria only due to laboratory interference that raises the reporting limit. Based on the results of this testing, HDR judges the planned development will not be adversely affected by the presence of the seven analytes listed in Table 4 at their currently detected concentrations.

7.0 RECOMMENDATIONS

Virginia provides flexibility in remediation for contaminants in soil or groundwater. HDR provides the following recommendations and options for future redevelopment of the property:

- Environmental concerns should be managed holistically with redevelopment. Although some analytes exceed the EPA Regional Screening Levels for Residential Soil, it can be managed onsite with design. For example, areas requiring fill can be constructed of on-site soils meeting the requirements discussed in the Geotechnical Engineering report and capped with paved trail or landscaping as identified in the grading and landscaping plans.

- Excess site soil (spoil), Soil Disposal Option 1 includes placement in another area of the larger Potomac Yards area. The Potomac Yards was historically a former railroad maintenance and storage facility. As such, impacts to soil on both this parcel and the remainder of the Potomac Yards are likely similar. It is acceptable to remove the soil to another area of the Potomac Yards provided the following criteria are met:
    - The destination is aware of the soil impacts and accepts the material;
    - One can demonstrate through analytical data that impacts to soil from both the origin and destination areas are analytically similar; and
    - Physical control requirements, as discussed in Bullet 1, are maintained; and

- Soil and Erosion control requirements are met on both the origin and destination properties.

Cost for this option can vary if soil and erosion controls are needed and for logistics in the transport of materials. It is difficult to accurately price this option at this time.

- Excess site soil (spoil), Soil Disposal Option 2 includes offsite disposal at a permitted landfill. Although it may cost more than Soil Disposal Option 1, it does remove potentially impacted spoil from the areas of development. HDR advises to seek out a permitted landfill that can accept the material at least six months in advance of construction to allow time for proper waste characterization and permit approval. The analytical results for this material are relatively low. Some landfills may provide a better rate to use this material as cover.

ATTACHMENTS

Table 1: Soil Comparison for 2014 VA Standards
Table 3: Soil Analytical Results
Analytical Data Reports

Table 1:

Soil comparison for 2014 VA standards

Native soil/fill	*Other Soils*	*Dredge Soils*	*Fly Ash*	*Central Operations/Free Product*	*Sediment*	*North Yard Tail Sediments*	*North Yard Sediments*	*Potomac Greens Sediment*
Inorganics				(Various depths)				(Various depths)
Aluminium	Aluminum				Aluminum	Copper	Aluminum	Arsenic
Antimony	Arsenic				Antimony	Iron	Antimony	Manganese
Arsenic	Chromium				Arsenic	Arsenic	Arsenic	Vanadium
Chromium	Iron				Chromium	Manganese	Chromium	Cobalt
Cobalt	Vanadium				Cobalt		Cobalt	Iron
Iron					Copper		Iron	Lead
Manganese					Iron		Lead	
Mercury					Lead		Manganese	
Vanadium					Manganese		Thailium	
					Thailium		Vanadium	
					Vanadium			
Semivolatiles								
1-Methylnaphthalene		Benzo[A] pyrene	Benzo[A] pyrene		Benzo[A] anthracene		Benzo[A] anthracene	Benzo[A] anthracene
Benzo[A] anthracene					Benzo[A] pyrene	Benzo[A] pyrene	Benzo[A] pyrene	Benzo[A] pyrene
Benzo[A] pyrene					Benzo[B] flouranthene	Dibenz[A,H]anthracene	Benzo[B] flouranthene	Benzo[B] flouranthene
Benzo[B] flouranthene					Dibenz[A,H]anthracene		Benzo[k] flourantene	Benzo[k] flourantene
Dibenz[A,H]anthracene					Indeno [1,2,3-C,D]pyrene		Dibenz[A,H]anthracene	Di-N-octyl phthalate
Naphthalene							Dibenzofuran	Indeno [1,2,3-C,D]pyrene
Phenathrene							Indeno [1,2,3-C,D]pyrene	Naphthalene
							Naphthalene	
Volatiles								
Trichloroethylene								
PCBs								
				Aroclor 1254 (Various depths)			PCB 1260	
				Aroclor 1016 (Various depths)				

*orange text means the mean if given also exceeds the standard

Table 3 - Summary of Chemical-Analytical Testing

LOCATION	CAS No.	EPA CAS No.	EPA Resident Soil Levels Threshold	Units	17BH-01 0-4'	17BH-01 4-10'	17BH-01 10-16'	17BH-02 0-6'	17BH-03 0-4'	17BH-03 4-10'	17BH-04 0-4'	17BH-04 4-10'	PCB Composite
SAMPLING DATE					42968	42968	42968	42968	42968	42968	42968	42968	42968
LAB SAMPLE ID					17H0710-03	17H0710-04	17H0710-05	17H0710-06	17H0710-01	17H0710-02	17H0710-07	17H0710-08	17H0710-09
SAMPLE TYPE					Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Test Name													
TAL Inorganics													
Aluminum	7429-90-5	7429-90-5	77000	mg/kg	6750	8220	10400	8510	15800	2520	8700	10900	NA
Antimony	7440-36-0	7440-36-0	31	mg/kg	<5.00	<5.00	<0.500	<0.500	<5.00	<5.00	<5.00	<5.00	NA
Arsenic	7440-38-2	7440-38-2	0.68	mg/kg	41.3	20.6	5.99	9.53	25.9	75.2	17.4	23.8	NA
Barium	7440-39-3	7440-39-3	15000	mg/kg	53.4	48.8	70.4	51.1	91.9	80.8	64.6	81.3	NA
Beryllium	7440-41-7	7440-41-7	160	mg/kg	<0.200	<0.200	<3.81	<0.200	<0.200	<0.367	<3.72	<3.91	NA
Cadmium (food, soil)	7440-43-9	7440-43-9	71	mg/kg	1.38	1.14	1.49	0.952	2.24	1.62	1.16	1.53	NA
Calcium	7440-70-2			mg/kg	3850	12900	434	1210	3520	2880	34000	27200	NA
Chromium	7440-47-3	7440-47-3		mg/kg	16.7	17.2	15.6	13.2	35.0	12.7	33.9	23.1	NA
Cobalt	7440-48-4	7440-48-4	23	mg/kg	7.48	8.62	9.80	11.8	18.5	5.19	7.37	10.8	NA
Copper	7440-50-8	7440-50-8	3100	mg/kg	20.1	16.1	10.7	9.55	38.6	71.3	20.6	30.6	NA
Cyanide	57-12-5			mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron	7439-89-6	7439-89-6	55000	mg/kg	15500	14000	19400	12200	29600	16900	14500	19100	NA
Lead	7439-92-1	7439-92-1	400	mg/kg	27.4	18.3	8.07	11.9	18.8	111	13.5	18.4	NA
Magnesium	7439-95-4			mg/kg	1410	2980	1390	1100	4640	809	6430	5060	NA
Manganese (nonfood)	7439-96-5	7439-96-5	1800	mg/kg	164	153	210	198	559	178	242	278	NA
Mercury, inorganic salts	7487-94-7			mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	7439-97-6	7439-97-6	11	mg/kg	0.029	0.021	0.020	0.023	0.044	0.073	0.020	0.031	NA
Methylmercury	22967-92-6			mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	7440-02-0	7440-02-0	1500	mg/kg	11.1	10.9	12.0	9.07	28.6	13.0	11.2	16.6	NA
Potassium	7440-09-7			mg/kg	749	870	768	705	2900	361	1220	1610	NA
Selenium	7782-49-2	7782-49-2	390	mg/kg	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	3.39	NA
Silver	7440-22-4	7440-22-4	390	mg/kg	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<5.00	NA
Sodium	7440-23-5			mg/kg	80.1	129	96.3	111	90.8	83.3	221	257	NA
Thallium	7440-28-0	7440-28-0	0.78	mg/kg	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	2.67	2.88	NA
Vanadium	NA	7440-62-2	390	mg/kg	2.25	23.7	24.7	20.9	72.3	12.5	28.0	37.4	NA
Zinc	7440-66-6	7440-66-6	23000	mg/kg	45.5	40.5	36.4	31.1	57.9	89.2	43.5	55.7	NA
Other Inorganics													
Perchlorate				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
TCL Volatile Organic Compounds (VOCs)													
Acetone	67-64-1	67-64-1	61000	mg/kg	<0.0100	0.0487	0.0111	<0.0100	<0.0100	<0.0100	0.130	0.0718	NA
Benzene	71-43-2	71-43-2	1.2	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
Bromochloromethane	74-97-5	74-97-5	150	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
Bromodichloromethane	75-27-4	75-27-4	0.29	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
Bromoform	75-25-2	75-25-2	19	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
Bromomethane	74-83-9	74-83-9	6.8	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
2-Butanone (methyl ethyl ketone)	78-93-3	78-93-3	27000	mg/kg	<0.00500	0.00591	<0.00500	<0.00500	<0.00500	0.0146	0.0117	0.00740	NA
Carbon disulfide	75-15-0	75-15-0	770	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
Carbon tetrachloride	56-23-5			mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzene	108-90-7	108-90-7	280	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
Chloroethane (Ethyl Chloride)	75-00-3	75-00-3	14000	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
Chloroform	67-66-3	67-66-3	0.32	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
Chloromethane	74-87-3	74-87-3	110	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
Cyclohexane	110-82-7	110-82-7	6500	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
1,2-Dibromo-3-chloropropane	96-12-8	96-12-8	0.0053	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
Dibromochloromethane	124-48-1	124-48-1	8.3	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
1,2-Dibromoethane	106-93-4	106-93-4	0.036	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
1,2-Dichlorobenzene (ortho)	95-50-1	95-50-1	1800	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
1,3-Dichlorobenzene (meta)	541-73-1			mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
1,4-Dichlorobenzene (para)	106-46-7	106-46-7	2.6	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
Dichlorodifluoromethane	75-71-8	75-71-8	87	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
1,1-Dichloroethane	75-34-3	75-34-3	3.6	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
1,2-Dichloroethane	107-06-2	107-06-2	0.46	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
1,1-Dichloroethene	75-35-4			mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
Removed from RSL List	540-59-0			mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	156-59-2			mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	156-60-5			mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	78-87-5	78-87-5	0.28	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
1,3-Dichloropropene (total)	542-75-6			mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	10061-01-5	542-75-6	1.8	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
trans-1,3-Dichloropropene	10061-02-6	542-75-6	1.8	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
1,4-dioxane	123-91-1	123-91-1	5.3	mg/kg	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	NA
Ethylbenzene	100-41-4	100-41-4	5.8	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
Hexane	110-54-3			mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Hexanone	591-78-6	591-78-6	200	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
Isopropylbenzene (cumene)	98-82-8	98-82-8	1900	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
4-Methyl-2-pentanone (methyl isobutyl ketone)	108-10-1	108-10-1	33000	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
Methyl acetate	79-20-9	79-20-9	78000	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA

Table 3 - Summary of Chemical-Analytical Testing

LOCATION	CAS No.	EPA CAS No.	EPA Resident Soil Levels Threshold	Units	17BH-01 0-4'	17BH-01 4-10'	17BH-01 10-16'	17BH-02 0-6'	17BH-03 0-4'	17BH-03 4-10'	17BH-04 0-4'	17BH-04 4-10'	PCB Composite
SAMPLING DATE					42968	42968	42968	42968	42968	42968	42968	42968	42968
LAB SAMPLE ID					17H0710-03	17H0710-04	17H0710-05	17H0710-06	17H0710-01	17H0710-02	17H0710-07	17H0710-08	17H0710-09
SAMPLE TYPE					Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Test Name													
Methyl tert-butyl ether	1634-04-4	1634-04-4	47	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
Methylcyclohexane	108-87-2			mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
Methylene chloride	75-09-2	75-09-2	57	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
Styrene	100-42-5	100-42-5	6000	mg/kg	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	NA
1,1,2,2-Tetrachloroethane	79-34-5	79-34-5	0.6	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
Tetrachloroethene	127-18-4			mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	108-88-3	108-88-3	4900	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	76-13-1	6700	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
1,2,3-Trichlorobenzene	87-61-6	87-61-6	63	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
1,2,4-Trichlorobenzene	120-82-1	120-82-1	24	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
1,1,1-Trichloroethane	71-55-6	71-55-6	8100	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
1,1,2-Trichloroethane	79-00-5	79-00-5	1.1	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
Trichloroethene	79-01-6			mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trichlorofluoromethane	75-69-4	75-69-4	23000	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
Vinyl Chloride	75-01-4	75-01-4	0.059	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
Total Xylenes	1330-20-7	1330-20-7	580	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
Other VOCs													
n-butylbenzene	104-51-8			mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
sec-butylbenzene	135-98-8			mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
tert-butylbenzene	98-06-6			mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
isopropyltoluene	99-87-6			mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-propylbenzene	103-65-1			mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,1,2-tetrachloroethane	630-20-6			mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4-trimethylbenzene	95-63-6			mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3,5-trimethylbenzene	108-67-8			mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
m-xylene	108-38-3	108-38-3	550	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
o-xylene	95-47-6	95-47-6	650	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
p-xylene	106-42-3	106-42-3	560	mg/kg	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	NA
TCL Semivolatile Organic Compounds (SVOCs)													
Acenaphthene	83-32-9	83-32-9	3600	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Acenaphthylene	208-96-8			mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Acetophenone	98-86-2	98-86-2	7800	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Anthracene	120-12-7	120-12-7	18000	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Atrazine	1912-24-9			mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Benzaldehyde	100-52-7			mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Benzo(a)anthracene	56-55-3	56-55-3	1.1	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Benzo(a)pyrene	50-32-8	50-32-8	0.11	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Benzo(b)fluoranthene	205-99-2	205-99-2	1.1	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	0.399	<0.330	<0.148	NA
Benzo(g,h,i)perylene	191-24-2			mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Benzo(k)fluoranthene	207-08-9	207-08-9	11	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
1,1'-Biphenyl	92-52-4	92-52-4	47	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
bis(2-Chloroethoxy)methane	111-91-1	111-91-1	190	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
bis(2-chloroethyl)ether	111-44-4	111-44-4	0.23	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
bis-(2-Ethylhexyl)phthalate	117-81-7	117-81-7	39	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
4-Bromophenyl-phenylether	101-55-3			mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Butylbenzylphthalate	85-68-7	85-68-7	290	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Caprolactam	105-60-2	105-60-2	31000	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Carbazole	86-74-8			mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
4-Chloro-3-methylphenol (Cresol p-chloro-m-)	59-50-7			mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chloroaniline	106-47-8			mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Chloronaphthalene	91-58-7	91-58-7	4800	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
2-Chlorophenol	95-57-8			mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
4-Chlorophenyl-phenylether	7005-72-3			mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Chrysene	218-01-9	218-01-9	110	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Dibutyl phthalate	84-74-2	84-74-2	6300	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Di-n-octylphthalate	117-84-0	117-84-0	630	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Dibenzo(a,h)anthracene	53-70-3	53-70-3	0.11	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Dibenzofuran	132-64-9	132-64-9	73	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
3,3'-Dichlorobenzidine	91-94-1	91-94-1	1.2	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
2,4-Dichlorophenol	120-83-2	120-83-2	190	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Diethylphthalate	84-66-2	84-66-2	51000	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
2,4-Dimethylphenol	105-67-9	105-67-9	1300	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Dimethylphthalate	131-11-3			mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
4,6-Dinitro-2-methylphenol (Dinitro-o-cresol, 4,6-)	534-52-1	534-52-1	5.1	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
2,4-Dinitrophenol	51-28-5	51-28-5	130	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
2,4-Dinitrotoluene	121-14-2	121-14-2	1.7	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
2,6-Dinitrotoluene	606-20-2	606-20-2	0.36	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Fluoranthene	206-44-0	206-44-0	2400	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA

Table 3 - Summary of Chemical-Analytical Testing

LOCATION	CAS No.	EPA CAS No.	EPA Resident Soil Levels Threshold	Units	17BH-01 0-4'	17BH-01 4-10'	17BH-01 10-16'	17BH-02 0-6'	17BH-03 0-4'	17BH-03 4-10'	17BH-04 0-4'	17BH-04 4-10'	PCB Composite
SAMPLING DATE					42968	42968	42968	42968	42968	42968	42968	42968	42968
LAB SAMPLE ID					17H0710-03	17H0710-04	17H0710-05	17H0710-06	17H0710-01	17H0710-02	17H0710-07	17H0710-08	17H0710-09
SAMPLE TYPE					Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Test Name													
Fluorene	86-73-7	86-73-7	2400	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Hexachlorobenzene	118-74-1	118-74-1	0.21	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Hexachlorobutadiene	87-68-3	87-68-3	1.2	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Hexachlorocyclopentadiene	77-47-4	77-47-4	1.8	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Hexachloroethane	67-72-1	67-72-1	1.8	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Indeno(1,2,3-cd)pyrene	193-39-5	193-39-5	1.1	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Isophorone	78-59-1	78-59-1	570	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
2-Methylnaphthalene	91-57-6	91-57-6	240	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
2-Methylphenol (Cresol, o-)	95-48-7	95-48-7	3200	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
3-Methylphenol (Cresol, m-)	108-39-4	108-39-4	3200	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
4-Methylphenol (Cresol, p-)	106-44-5	106-44-5	6300	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
N-Nitroso-di-n-propylamine	621-64-7	621-64-7	0.078	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
N-Nitrosodiphenylamine	86-30-6			mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Naphthalene	91-20-3	91-20-3	3.8	mg/kg	<0.0890	<0.0457	<0.0230	<0.0230	<0.0914	<0.0896	<0.0911	<0.0408	NA
2-Nitroaniline	88-74-4	88-74-4	630	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
3-Nitroaniline	99-09-2			mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
4-Nitroaniline	100-01-6	100-01-6	27	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Nitrobenzene	98-95-3	98-95-3	5.1	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
2-Nitrophenol	88-75-5			mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
4-Nitrophenol	100-02-7			mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
2,2'-Oxybis (Bis(2-chloro-1-methylethyl)ether)	108-60-1	108-60-1	3100	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Pentachlorophenol	87-86-5	87-86-5	1	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Phenanthrene	85-01-8			mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Phenol	108-95-2	108-95-2	19000	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Pyrene	129-00-0			mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4,5-Tetrachlorobenzene	95-94-3	95-94-3	23	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
2,3,4,6-Tetrachlorophenol	58-90-2	58-90-2	1900	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
2,4,5-Trichlorophenol	95-95-4	95-95-4	6300	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
2,4,6-Trichlorophenol	88-06-2	88-06-2	49	mg/kg	<0.322	<0.165	<0.0833	<0.0833	<0.331	<0.325	<0.330	<0.148	NA
Semivolatile Organic Compounds (SVOCs)													
Benzoic Acid	65-85-0			mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
TCL Polychlorinated Biphenyls (PCBs)													
Aroclor-1016	12674-11-2	12674-11-2	4.1	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	<0.115
Aroclor-1221	11104-28-2	11104-28-2	0.2	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	<0.115
Aroclor-1232	11141-16-5	11141-16-5	0.17	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	<0.115
Aroclor-1242	53469-21-9	53469-21-9	0.23	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	<0.115
Aroclor-1248	12672-29-6	12672-29-6	0.23	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	<0.115
Aroclor-1254	11097-69-1	11097-69-1	0.24	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	*<0.115*
Aroclor-1260	11096-82-5	11096-82-5	0.24	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	<0.115
Aroclor-1262				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1268				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total PCBs				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
TCL Pesticides													
Aldrin				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
alpha-BHC (Hexachlorocyclohexane, alpha-)				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
beta-BHC (Hexachlorocyclohexane, beta-)				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
delta-BHC ((Hexachlorocyclohexane, delta-)				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
gamma-BHC (lindane)				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlordane				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
alpha-Chlordane				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
gamma-Chlordane				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDD				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan I				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan II				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan Sulfate				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endrin				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endrin Aldehyde				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endrin Ketone				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor epoxide				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methoxychlor				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toxaphene				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlorinated dioxins/dibenzofurans (CDDs/CDFs)													
2,3,7,8-TCDD				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 3 - Summary of Chemical-Analytical Testing

LOCATION	CAS No.	EPA CAS No.	EPA Resident Soil Levels Threshold	Units	17BH-01 0-4'	17BH-01 4-10'	17BH-01 10-16'	17BH-02 0-6'	17BH-03 0-4'	17BH-03 4-10'	17BH-04 0-4'	17BH-04 4-10'	PCB Composite
SAMPLING DATE					42968	42968	42968	42968	42968	42968	42968	42968	42968
LAB SAMPLE ID					17H0710-03	17H0710-04	17H0710-05	17H0710-06	17H0710-01	17H0710-02	17H0710-07	17H0710-08	17H0710-09
SAMPLE TYPE					Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Test Name													
2,3,7,8-TCDF				mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA

the detection limit of this non-detected compound exceeds the EPA Soil Level Threshold
indicated the compound was detected above the EPA Resident Soil Level Threshold

AIR WATER & SOIL LABORATORIES, INC.

1941 Reymet Road ● Richmond, Virginia 23237 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Laboratory Order ID 17H0710

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen, VA 23060	Date Received:	August 22, 2017 10:05
		Date Issued:	August 30, 2017 10:53
		Project Number:	10055101
Submitted To:	Joe Wallen	Purchase Order:	
Client Site I.D.:	Four Mile Run		

Enclosed are the results of analyses for samples received by the laboratory on 08/22/2017 10:05. If you have any questions concerning this report, please feel free to contact the laboratory.

Sincerely,

Ted Soyars

Laboratory Manager

End Notes:

The test results listed in this report relate only to the samples submitted to the laboratory and as received by the Laboratory.

Unless otherwise noted, the test results for solid materials are calculated on a wet weight basis. Analyses for pH, dissolved oxygen, temperature, residual chlorine and sulfite that are performed in the laboratory do not meet NELAC requirements due to extremely short holding times. These analyses should be performed in the field. The results of field analyses performed by the Sampler included in the Certificate of Analysis are done so at the client's request and are not included in the laboratory's fields of certification nor have they been audited for adherence to a reference method or procedure.

The signature on the final report certifies that these results conform to all applicable NELAC standards unless otherwise specified. For a complete list of the Laboratory's NELAC certified parameters please contact customer service.

Accredited in accordance with nelac — Commonwealth of Virginia, DCLS Accreditation # 460021

NWBOC EDWOSB Certified

Certified SWaM Small, Women and Minority-Owned — Supplier Diversity Strengthens the Commonwealth — by the Virginia Department of Minority Business Enterprise

AIR WATER & SOIL LABORATORIES, INC.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

ANALYTICAL REPORT FOR SAMPLES

Laboratory Order ID 17H0710

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
17BH-03 0-4'	17H0710-01	Soil	08/21/2017 08:45	08/22/2017 10:05
17BH-03 4-10'	17H0710-02	Soil	08/21/2017 09:00	08/22/2017 10:05
17BH-01 0-4'	17H0710-03	Soil	08/21/2017 10:00	08/22/2017 10:05
17BH-01 4-10'	17H0710-04	Soil	08/21/2017 10:10	08/22/2017 10:05
17BH-01 10-16'	17H0710-05	Soil	08/21/2017 10:20	08/22/2017 10:05
17BH-02 0-6'	17H0710-06	Soil	08/21/2017 11:40	08/22/2017 10:05
17BH-04 0-4'	17H0710-07	Soil	08/21/2017 12:45	08/22/2017 10:05
17BH-04 4-10'	17H0710-08	Soil	08/21/2017 13:05	08/22/2017 10:05
17BH PCB Composite	17H0710-09	Soil	08/21/2017 08:45 to 08/21/2017 13:05	08/22/2017 10:05

PCB results have been calculated based on dry weight.

This Certificate of Analysis is being reissued on August 30, 2017 to correct sample ID's per client request.

AIR WATER SOIL LABORATORIES, INC.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-03 0-4' **Laboratory Sample ID:** 17H0710-01

Composite Start-End Date/Time: 08/21/2017 08:45 - 08/21/2017 08:45

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Metals (Total) by EPA 6000/7000 Series Methods									
Silver	01	SW6010C	<0.500 mg/kg		0.500	1	08/23/17 08:45	08/24/17 17:13	CWO
Aluminum	01RE1	SW6010C	**15800 mg/kg**		125	50	08/23/17 08:45	08/25/17 13:50	CWO
Arsenic	01	SW6010C	**25.9 mg/kg**		1.00	1	08/23/17 08:45	08/24/17 17:13	CWO
Barium	01	SW6010C	**91.9 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:13	CWO
Beryllium	01	SW6010C	<0.200 mg/kg		0.200	1	08/23/17 08:45	08/24/17 17:13	CWO
Calcium	01RE1	SW6010C	**3520 mg/kg**		498	100	08/23/17 08:45	08/24/17 16:48	CWO
Cadmium	01	SW6010C	**2.24 mg/kg**		0.200	1	08/23/17 08:45	08/24/17 17:13	CWO
Cobalt	01	SW6010C	**18.5 mg/kg**		0.200	1	08/23/17 08:45	08/24/17 17:13	CWO
Chromium	01	SW6010C	**35.0 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:13	CWO
Copper	01	SW6010C	**38.6 mg/kg**		2.50	1	08/23/17 08:45	08/24/17 17:13	CWO
Iron	01RE1	SW6010C	**29600 mg/kg**		249	100	08/23/17 08:45	08/24/17 16:48	CWO
Mercury	01	SW7471B	**0.044 mg/kg**		0.008	1	08/23/17 13:17	08/28/17 11:52	MWL
Potassium	01	SW6010C	**2900 mg/kg**		25.0	1	08/23/17 08:45	08/23/17 16:52	CWO
Magnesium	01RE1	SW6010C	**4640 mg/kg**		249	100	08/23/17 08:45	08/24/17 16:48	CWO
Manganese	01	SW6010C	**559 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:13	CWO
Sodium	01	SW6010C	**90.8 mg/kg**		25.0	1	08/23/17 08:45	08/23/17 16:52	CWO
Nickel	01	SW6010C	**28.6 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:13	CWO
Lead	01RE1	SW6010C	**18.8 mg/kg**		0.500	1	08/23/17 08:45	08/23/17 16:55	CWO
Antimony	01	SW6010C	<5.00 mg/kg		5.00	1	08/23/17 08:45	08/24/17 17:13	CWO
Selenium	01	SW6010C	<2.50 mg/kg		2.50	1	08/23/17 08:45	08/24/17 17:13	CWO
Thallium	01	SW6010C	<2.50 mg/kg		2.50	1	08/23/17 08:45	08/24/17 17:13	CWO
Vanadium	01	SW6010C	**72.3 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:13	CWO
Zinc	01	SW6010C	**57.9 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:13	CWO
Volatile Organic Compounds by GCMS									
1,1,1-Trichloroethane	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
1,1,2,2-Tetrachloroethane	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW

AIR WATER SOIL LABORATORIES, INC.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-03 0-4' **Laboratory Sample ID:** 17H0710-01

Composite Start-End Date/Time: 08/21/2017 08:45 - 08/21/2017 08:45

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Volatile Organic Compounds by GCMS									
1,1,2-Trichloro-1,2,2-trifluoro ethane	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
1,1,2-Trichloroethane	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
1,1-Dichloroethane	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
1,1-Dichloroethylene	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
1,2,3-Trichlorobenzene	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
1,2,4-Trichlorobenzene	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
1,2-Dibromo-3-chloropropane (DBCP)	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
1,2-Dibromoethane (EDB)	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
1,2-Dichlorobenzene	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
1,2-Dichloroethane	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
1,2-Dichloropropane	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
1,3-Dichlorobenzene	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
1,4-Dichlorobenzene	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
1,4-Dioxane	01	SW8260B	<100 ug/kg		100	1	08/23/17 17:12	08/23/17 17:12	JDW
2-Butanone (MEK)	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
2-Hexanone (MBK)	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
4-Methyl-2-pentanone (MIBK)	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
Acetone	01	SW8260B	<10.0 ug/kg		10.0	1	08/23/17 17:12	08/23/17 17:12	JDW
Benzene	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
Bromochloromethane	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
Bromodichloromethane	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
Bromoform	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
Bromomethane	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
Carbon disulfide	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
Chlorobenzene	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW

AIR WATER SOIL LABORATORIES, INC.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-03 0-4' **Laboratory Sample ID:** 17H0710-01

Composite Start-End Date/Time: 08/21/2017 08:45 - 08/21/2017 08:45

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Volatile Organic Compounds by GCMS									
Chloroethane	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
Chloroform	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
Chloromethane	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
cis-1,2-Dichloroethylene	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
cis-1,3-Dichloropropene	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
Cyclohexane	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
Dibromochloromethane	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
Dichlorodifluoromethane	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
Ethylbenzene	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
Isopropylbenzene	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
m+p-Xylenes	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
Methyl acetate	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
Methyl cyclohexane	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
Methylene chloride	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
Methyl-t-butyl ether (MTBE)	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
o-Xylene	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
Styrene	01	SW8260B	<10.0 ug/kg		10.0	1	08/23/17 17:12	08/23/17 17:12	JDW
Tetrachloroethylene (PCE)	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
Toluene	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
trans-1,2-Dichloroethylene	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
trans-1,3-Dichloropropene	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
Trichloroethylene	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
Trichlorofluoromethane	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
Vinyl chloride	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW
Xylenes, Total	01	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:12	08/23/17 17:12	JDW

AIR WATER SOIL LABORATORIES, INC.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-03 0-4' **Laboratory Sample ID:** 17H0710-01

Composite Start-End Date/Time: 08/21/2017 08:45 - 08/21/2017 08:45

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Volatile Organic Compounds by GCMS									
Surr: 1,2-Dichloroethane-d4 (Surr)	*01*	*SW8260B*	*105 %*		*80-120*		*08/23/17 17:12*	*08/23/17 17:12*	*JDW*
Surr: 4-Bromofluorobenzene (Surr)	*01*	*SW8260B*	*101 %*		*85-120*		*08/23/17 17:12*	*08/23/17 17:12*	*JDW*
Surr: Dibromofluoromethane (Surr)	*01*	*SW8260B*	*108 %*		*78-119*		*08/23/17 17:12*	*08/23/17 17:12*	*JDW*
Surr: Toluene-d8 (Surr)	*01*	*SW8260B*	*104 %*		*85-115*		*08/23/17 17:12*	*08/23/17 17:12*	*JDW*
Semivolatile Organic Compounds by GCMS									
1,1-Biphenyl	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
1,2,4,5-Tetrachlorobenzene	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
2,3,4,6-Tetrachlorophenol	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
2,4,5-Trichlorophenol	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
2,4,6-Trichlorophenol	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
2,4-Dichlorophenol	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
2,4-Dimethylphenol	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
2,4-Dinitrophenol	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
2,4-Dinitrotoluene	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
2,6-Dinitrotoluene	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
2-Chloronaphthalene	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
2-Chlorophenol	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
2-Methylnaphthalene	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
2-Nitroaniline	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
2-Nitrophenol	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
3,3'-Dichlorobenzidine	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
3-Nitroaniline	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
4,6-Dinitro-2-methylphenol	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
4-Bromophenyl phenyl ether	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS

AIR WATER SOIL LABORATORIES, INC.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-03 0-4' **Laboratory Sample ID:** 17H0710-01

Composite Start-End Date/Time: 08/21/2017 08:45 - 08/21/2017 08:45

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Semivolatile Organic Compounds by GCMS									
4-Chlorophenyl phenyl ether	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
4-Nitroaniline	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
4-Nitrophenol	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Acenaphthene	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Acenaphthylene	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Acetophenone	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Anthracene	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Atrazine	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Benzaldehyde	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Benzo (a) anthracene	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Benzo (a) pyrene	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Benzo (b) fluoranthene	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Benzo (g,h,i) perylene	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Benzo (k) fluoranthene	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
bis (2-Chloroethoxy) methane	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
bis (2-Chloroethyl) ether	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
2,2'-Oxybis (1-chloropropane)	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
bis (2-Ethylhexyl) phthalate	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Butyl benzyl phthalate	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Caprolactam	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Carbazole	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Chrysene	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Dibenz (a,h) anthracene	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Dibenzofuran	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Diethyl phthalate	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Dimethyl phthalate	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS

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Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-03 0-4' **Laboratory Sample ID:** 17H0710-01

Composite Start-End Date/Time: 08/21/2017 08:45 - 08/21/2017 08:45

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Semivolatile Organic Compounds by GCMS									
Di-n-butyl phthalate	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Di-n-octyl phthalate	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Fluoranthene	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Fluorene	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Hexachlorobenzene	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Hexachlorobutadiene	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Hexachlorocyclopentadiene	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Hexachloroethane	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Indeno (1,2,3-cd) pyrene	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Isophorone	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
m+p-Cresols	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Naphthalene	01	SW8270D	<91.4 ug/kg		91.4	4	08/25/17 09:45	08/28/17 16:56	SKS
Nitrobenzene	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
n-Nitrosodi-n-propylamine	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
n-Nitrosodiphenylamine	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
o-Cresol	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
p-Chloro-m-cresol	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Pentachlorophenol	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Phenanthrene	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Phenol	01	SW8270D	<331 ug/kg		331	4	08/25/17 09:45	08/28/17 16:56	SKS
Surr: 2,4,6-Tribromophenol (Surr)	*01*	*SW8270D*	*59.1 %*		*35-125*		*08/25/17 09:45*	*08/28/17 16:56*	*SKS*
Surr: 2-Fluorobiphenyl (Surr)	*01*	*SW8270D*	*61.4 %*		*45-105*		*08/25/17 09:45*	*08/28/17 16:56*	*SKS*
Surr: 2-Fluorophenol (Surr)	*01*	*SW8270D*	*61.1 %*		*35-105*		*08/25/17 09:45*	*08/28/17 16:56*	*SKS*
Surr: Nitrobenzene-d5 (Surr)	*01*	*SW8270D*	*71.2 %*		*35-100*		*08/25/17 09:45*	*08/28/17 16:56*	*SKS*
Surr: Phenol-d5 (Surr)	*01*	*SW8270D*	*61.4 %*		*40-100*		*08/25/17 09:45*	*08/28/17 16:56*	*SKS*
Surr: p-Terphenyl-d14 (Surr)	*01*	*SW8270D*	*101 %*		*30-125*		*08/25/17 09:45*	*08/28/17 16:56*	*SKS*

AIR WATER SOIL LABORATORIES, INC.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-03 0-4' **Laboratory Sample ID:** 17H0710-01

Composite Start-End Date/Time: 08/21/2017 08:45 - 08/21/2017 08:45

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Wet Chemistry Analysis									
Percent Solids	01	SM18 2540G	**82.6 %**		0.10	1	08/23/17 15:15	08/23/17 15:15	JCM

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Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-03 4-10' **Laboratory Sample ID:** 17H0710-02

Composite Start-End Date/Time: 08/21/2017 09:00 - 08/21/2017 09:00

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Metals (Total) by EPA 6000/7000 Series Methods									
Silver	02	SW6010C	<0.500 mg/kg		0.500	1	08/23/17 08:45	08/24/17 17:18	CWO
Aluminum	02RE1	SW6010C	**2520 mg/kg**		57.3	25	08/23/17 08:45	08/25/17 14:12	CWO
Arsenic	02	SW6010C	**75.2 mg/kg**		1.00	1	08/23/17 08:45	08/24/17 17:18	CWO
Barium	02	SW6010C	**80.8 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:18	CWO
Beryllium	02RE1	SW6010C	<0.367 mg/kg		0.367	2	08/23/17 08:45	08/25/17 15:51	CWO
Calcium	02RE1	SW6010C	**2880 mg/kg**		229	50	08/23/17 08:45	08/24/17 16:50	CWO
Cadmium	02	SW6010C	**1.62 mg/kg**		0.200	1	08/23/17 08:45	08/24/17 17:18	CWO
Cobalt	02	SW6010C	**5.19 mg/kg**		0.200	1	08/23/17 08:45	08/24/17 17:18	CWO
Chromium	02	SW6010C	**12.7 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:18	CWO
Copper	02	SW6010C	**71.3 mg/kg**		2.50	1	08/23/17 08:45	08/24/17 17:18	CWO
Iron	02RE1	SW6010C	**16900 mg/kg**		115	50	08/23/17 08:45	08/24/17 16:50	CWO
Mercury	02	SW7471B	**0.073 mg/kg**		0.008	1	08/23/17 13:17	08/28/17 12:06	MWL
Potassium	02	SW6010C	**361 mg/kg**		25.0	1	08/23/17 08:45	08/23/17 17:11	CWO
Magnesium	02	SW6010C	**809 mg/kg**		2.50	1	08/23/17 08:45	08/24/17 17:18	CWO
Manganese	02	SW6010C	**178 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:18	CWO
Sodium	02	SW6010C	**83.3 mg/kg**		25.0	1	08/23/17 08:45	08/23/17 17:11	CWO
Nickel	02	SW6010C	**13.0 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:18	CWO
Lead	02RE1	SW6010C	**111 mg/kg**		0.500	1	08/23/17 08:45	08/23/17 17:13	CWO
Antimony	02	SW6010C	<5.00 mg/kg		5.00	1	08/23/17 08:45	08/24/17 17:18	CWO
Selenium	02	SW6010C	<2.50 mg/kg		2.50	1	08/23/17 08:45	08/24/17 17:18	CWO
Thallium	02	SW6010C	<2.50 mg/kg		2.50	1	08/23/17 08:45	08/24/17 17:18	CWO
Vanadium	02	SW6010C	**12.5 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:18	CWO
Zinc	02	SW6010C	**89.2 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:18	CWO
Volatile Organic Compounds by GCMS									
1,1,1-Trichloroethane	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
1,1,2,2-Tetrachloroethane	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW

AIR WATER SOIL LABORATORIES, INC.

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Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-03 4-10' **Laboratory Sample ID:** 17H0710-02

Composite Start-End Date/Time: 08/21/2017 09:00 - 08/21/2017 09:00

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Volatile Organic Compounds by GCMS									
1,1,2-Trichloro-1,2,2-trifluoro ethane	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
1,1,2-Trichloroethane	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
1,1-Dichloroethane	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
1,1-Dichloroethylene	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
1,2,3-Trichlorobenzene	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
1,2,4-Trichlorobenzene	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
1,2-Dibromo-3-chloropropane (DBCP)	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
1,2-Dibromoethane (EDB)	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
1,2-Dichlorobenzene	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
1,2-Dichloroethane	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
1,2-Dichloropropane	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
1,3-Dichlorobenzene	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
1,4-Dichlorobenzene	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
1,4-Dioxane	02	SW8260B	<100 ug/kg		100	1	08/23/17 17:35	08/23/17 17:35	JDW
2-Butanone (MEK)	02	SW8260B	**14.6 ug/kg**		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
2-Hexanone (MBK)	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
4-Methyl-2-pentanone (MIBK)	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
Acetone	02	SW8260B	<10.0 ug/kg		10.0	1	08/23/17 17:35	08/23/17 17:35	JDW
Benzene	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
Bromochloromethane	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
Bromodichloromethane	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
Bromoform	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
Bromomethane	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
Carbon disulfide	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
Chlorobenzene	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW

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Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-03 4-10' **Laboratory Sample ID:** 17H0710-02

Composite Start-End Date/Time: 08/21/2017 09:00 - 08/21/2017 09:00

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Volatile Organic Compounds by GCMS									
Chloroethane	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
Chloroform	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
Chloromethane	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
cis-1,2-Dichloroethylene	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
cis-1,3-Dichloropropene	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
Cyclohexane	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
Dibromochloromethane	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
Dichlorodifluoromethane	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
Ethylbenzene	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
Isopropylbenzene	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
m+p-Xylenes	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
Methyl acetate	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
Methyl cyclohexane	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
Methylene chloride	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
Methyl-t-butyl ether (MTBE)	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
o-Xylene	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
Styrene	02	SW8260B	<10.0 ug/kg		10.0	1	08/23/17 17:35	08/23/17 17:35	JDW
Tetrachloroethylene (PCE)	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
Toluene	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
trans-1,2-Dichloroethylene	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
trans-1,3-Dichloropropene	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
Trichloroethylene	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
Trichlorofluoromethane	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
Vinyl chloride	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW
Xylenes, Total	02	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:35	08/23/17 17:35	JDW

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Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-03 4-10' **Laboratory Sample ID:** 17H0710-02

Composite Start-End Date/Time: 08/21/2017 09:00 - 08/21/2017 09:00

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Volatile Organic Compounds by GCMS									
Surr: 1,2-Dichloroethane-d4 (Surr)	*02*	*SW8260B*	*108 %*		*80-120*		*08/23/17 17:35*	*08/23/17 17:35*	*JDW*
Surr: 4-Bromofluorobenzene (Surr)	*02*	*SW8260B*	*91.1 %*		*85-120*		*08/23/17 17:35*	*08/23/17 17:35*	*JDW*
Surr: Dibromofluoromethane (Surr)	*02*	*SW8260B*	*105 %*		*78-119*		*08/23/17 17:35*	*08/23/17 17:35*	*JDW*
Surr: Toluene-d8 (Surr)	*02*	*SW8260B*	*103 %*		*85-115*		*08/23/17 17:35*	*08/23/17 17:35*	*JDW*
Semivolatile Organic Compounds by GCMS									
1,1-Biphenyl	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
1,2,4,5-Tetrachlorobenzene	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
2,3,4,6-Tetrachlorophenol	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
2,4,5-Trichlorophenol	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
2,4,6-Trichlorophenol	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
2,4-Dichlorophenol	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
2,4-Dimethylphenol	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
2,4-Dinitrophenol	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
2,4-Dinitrotoluene	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
2,6-Dinitrotoluene	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
2-Chloronaphthalene	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
2-Chlorophenol	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
2-Methylnaphthalene	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
2-Nitroaniline	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
2-Nitrophenol	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
3,3'-Dichlorobenzidine	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
3-Nitroaniline	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
4,6-Dinitro-2-methylphenol	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
4-Bromophenyl phenyl ether	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS

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Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-03 4-10' **Laboratory Sample ID:** 17H0710-02

Composite Start-End Date/Time: 08/21/2017 09:00 - 08/21/2017 09:00

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Semivolatile Organic Compounds by GCMS									
4-Chlorophenyl phenyl ether	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
4-Nitroaniline	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
4-Nitrophenol	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Acenaphthene	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Acenaphthylene	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Acetophenone	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Anthracene	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Atrazine	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Benzaldehyde	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Benzo (a) anthracene	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Benzo (a) pyrene	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Benzo (b) fluoranthene	02	SW8270D	**399 ug/kg**		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Benzo (g,h,i) perylene	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Benzo (k) fluoranthene	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
bis (2-Chloroethoxy) methane	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
bis (2-Chloroethyl) ether	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
2,2'-Oxybis (1-chloropropane)	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
bis (2-Ethylhexyl) phthalate	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Butyl benzyl phthalate	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Caprolactam	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Carbazole	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Chrysene	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Dibenz (a,h) anthracene	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Dibenzofuran	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Diethyl phthalate	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Dimethyl phthalate	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS

AIR WATER SOIL LABORATORIES, INC.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-03 4-10' **Laboratory Sample ID:** 17H0710-02

Composite Start-End Date/Time: 08/21/2017 09:00 - 08/21/2017 09:00

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Semivolatile Organic Compounds by GCMS									
Di-n-butyl phthalate	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Di-n-octyl phthalate	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Fluoranthene	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Fluorene	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Hexachlorobenzene	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Hexachlorobutadiene	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Hexachlorocyclopentadiene	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Hexachloroethane	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Indeno (1,2,3-cd) pyrene	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Isophorone	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
m+p-Cresols	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Naphthalene	02	SW8270D	<89.6 ug/kg		89.6	4	08/25/17 09:45	08/28/17 17:33	SKS
Nitrobenzene	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
n-Nitrosodi-n-propylamine	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
n-Nitrosodiphenylamine	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
o-Cresol	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
p-Chloro-m-cresol	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Pentachlorophenol	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Phenanthrene	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Phenol	02	SW8270D	<325 ug/kg		325	4	08/25/17 09:45	08/28/17 17:33	SKS
Surr: 2,4,6-Tribromophenol (Surr)	*02*	*SW8270D*	*48.8 %*		*35-125*		*08/25/17 09:45*	*08/28/17 17:33*	*SKS*
Surr: 2-Fluorobiphenyl (Surr)	*02*	*SW8270D*	*62.1 %*		*45-105*		*08/25/17 09:45*	*08/28/17 17:33*	*SKS*
Surr: 2-Fluorophenol (Surr)	*02*	*SW8270D*	*51.6 %*		*35-105*		*08/25/17 09:45*	*08/28/17 17:33*	*SKS*
Surr: Nitrobenzene-d5 (Surr)	*02*	*SW8270D*	*60.1 %*		*35-100*		*08/25/17 09:45*	*08/28/17 17:33*	*SKS*
Surr: Phenol-d5 (Surr)	*02*	*SW8270D*	*47.4 %*		*40-100*		*08/25/17 09:45*	*08/28/17 17:33*	*SKS*
Surr: p-Terphenyl-d14 (Surr)	*02*	*SW8270D*	*84.5 %*		*30-125*		*08/25/17 09:45*	*08/28/17 17:33*	*SKS*

AIR WATER & SOIL LABORATORIES, INC.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-03 4-10' **Laboratory Sample ID:** 17H0710-02

Composite Start-End Date/Time: 08/21/2017 09:00 - 08/21/2017 09:00

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Wet Chemistry Analysis									
Percent Solids	02	SM18 2540G	**86.8 %**		0.10	1	08/23/17 15:15	08/23/17 15:15	JCM

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Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-01 0-4' **Laboratory Sample ID:** 17H0710-03

Composite Start-End Date/Time: 08/21/2017 10:00 - 08/21/2017 10:00

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Metals (Total) by EPA 6000/7000 Series Methods									
Silver	03	SW6010C	<0.500 mg/kg		0.500	1	08/23/17 08:45	08/24/17 17:20	CWO
Aluminum	03RE1	SW6010C	**6750 mg/kg**		60.6	25	08/23/17 08:45	08/25/17 14:16	CWO
Arsenic	03	SW6010C	**41.3 mg/kg**		1.00	1	08/23/17 08:45	08/24/17 17:20	CWO
Barium	03	SW6010C	**53.4 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:20	CWO
Beryllium	03	SW6010C	<0.200 mg/kg		0.200	1	08/23/17 08:45	08/24/17 17:20	CWO
Calcium	03RE1	SW6010C	**3850 mg/kg**		242	50	08/23/17 08:45	08/24/17 16:51	CWO
Cadmium	03	SW6010C	**1.38 mg/kg**		0.200	1	08/23/17 08:45	08/24/17 17:20	CWO
Cobalt	03	SW6010C	**7.48 mg/kg**		0.200	1	08/23/17 08:45	08/24/17 17:20	CWO
Chromium	03	SW6010C	**16.7 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:20	CWO
Copper	03	SW6010C	**20.1 mg/kg**		2.50	1	08/23/17 08:45	08/24/17 17:20	CWO
Iron	03RE1	SW6010C	**15500 mg/kg**		121	50	08/23/17 08:45	08/24/17 16:51	CWO
Mercury	03	SW7471B	**0.029 mg/kg**		0.008	1	08/23/17 13:17	08/28/17 12:08	MWL
Potassium	03	SW6010C	**749 mg/kg**		25.0	1	08/23/17 08:45	08/23/17 17:17	CWO
Magnesium	03RE1	SW6010C	**1410 mg/kg**		121	50	08/23/17 08:45	08/24/17 16:52	CWO
Manganese	03	SW6010C	**164 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:20	CWO
Sodium	03	SW6010C	**80.1 mg/kg**		25.0	1	08/23/17 08:45	08/23/17 17:17	CWO
Nickel	03	SW6010C	**11.1 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:20	CWO
Lead	03RE1	SW6010C	**27.4 mg/kg**		0.500	1	08/23/17 08:45	08/23/17 17:19	CWO
Antimony	03	SW6010C	<5.00 mg/kg		5.00	1	08/23/17 08:45	08/24/17 17:20	CWO
Selenium	03	SW6010C	<2.50 mg/kg		2.50	1	08/23/17 08:45	08/24/17 17:20	CWO
Thallium	03	SW6010C	<2.50 mg/kg		2.50	1	08/23/17 08:45	08/24/17 17:20	CWO
Vanadium	03	SW6010C	**22.5 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:20	CWO
Zinc	03	SW6010C	**45.5 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:20	CWO
Volatile Organic Compounds by GCMS									
1,1,1-Trichloroethane	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
1,1,2,2-Tetrachloroethane	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW

AIR WATER SOIL LABORATORIES, INC.

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Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-01 0-4' **Laboratory Sample ID:** 17H0710-03

Composite Start-End Date/Time: 08/21/2017 10:00 - 08/21/2017 10:00

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Volatile Organic Compounds by GCMS									
1,1,2-Trichloro-1,2,2-trifluoro ethane	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
1,1,2-Trichloroethane	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
1,1-Dichloroethane	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
1,1-Dichloroethylene	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
1,2,3-Trichlorobenzene	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
1,2,4-Trichlorobenzene	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
1,2-Dibromo-3-chloropropane (DBCP)	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
1,2-Dibromoethane (EDB)	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
1,2-Dichlorobenzene	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
1,2-Dichloroethane	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
1,2-Dichloropropane	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
1,3-Dichlorobenzene	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
1,4-Dichlorobenzene	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
1,4-Dioxane	03	SW8260B	<100 ug/kg		100	1	08/23/17 17:59	08/23/17 17:59	JDW
2-Butanone (MEK)	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
2-Hexanone (MBK)	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
4-Methyl-2-pentanone (MIBK)	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
Acetone	03	SW8260B	<10.0 ug/kg		10.0	1	08/23/17 17:59	08/23/17 17:59	JDW
Benzene	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
Bromochloromethane	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
Bromodichloromethane	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
Bromoform	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
Bromomethane	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
Carbon disulfide	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
Chlorobenzene	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW

AIR WATER SOIL LABORATORIES, INC.

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Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-01 0-4' **Laboratory Sample ID:** 17H0710-03

Composite Start-End Date/Time: 08/21/2017 10:00 - 08/21/2017 10:00

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Volatile Organic Compounds by GCMS									
Chloroethane	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
Chloroform	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
Chloromethane	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
cis-1,2-Dichloroethylene	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
cis-1,3-Dichloropropene	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
Cyclohexane	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
Dibromochloromethane	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
Dichlorodifluoromethane	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
Ethylbenzene	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
Isopropylbenzene	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
m+p-Xylenes	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
Methyl acetate	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
Methyl cyclohexane	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
Methylene chloride	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
Methyl-t-butyl ether (MTBE)	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
o-Xylene	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
Styrene	03	SW8260B	<10.0 ug/kg		10.0	1	08/23/17 17:59	08/23/17 17:59	JDW
Tetrachloroethylene (PCE)	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
Toluene	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
trans-1,2-Dichloroethylene	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
trans-1,3-Dichloropropene	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
Trichloroethylene	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
Trichlorofluoromethane	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
Vinyl chloride	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW
Xylenes, Total	03	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 17:59	08/23/17 17:59	JDW

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Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-01 0-4' **Laboratory Sample ID:** 17H0710-03

Composite Start-End Date/Time: 08/21/2017 10:00 - 08/21/2017 10:00

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Volatile Organic Compounds by GCMS									
Surr: 1,2-Dichloroethane-d4 (Surr)	*03*	*SW8260B*	*104 %*		*80-120*		*08/23/17 17:59*	*08/23/17 17:59*	*JDW*
Surr: 4-Bromofluorobenzene (Surr)	*03*	*SW8260B*	*99.7 %*		*85-120*		*08/23/17 17:59*	*08/23/17 17:59*	*JDW*
Surr: Dibromofluoromethane (Surr)	*03*	*SW8260B*	*105 %*		*78-119*		*08/23/17 17:59*	*08/23/17 17:59*	*JDW*
Surr: Toluene-d8 (Surr)	*03*	*SW8260B*	*106 %*		*85-115*		*08/23/17 17:59*	*08/23/17 17:59*	*JDW*
Semivolatile Organic Compounds by GCMS									
1,1-Biphenyl	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
1,2,4,5-Tetrachlorobenzene	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
2,3,4,6-Tetrachlorophenol	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
2,4,5-Trichlorophenol	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
2,4,6-Trichlorophenol	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
2,4-Dichlorophenol	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
2,4-Dimethylphenol	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
2,4-Dinitrophenol	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
2,4-Dinitrotoluene	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
2,6-Dinitrotoluene	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
2-Chloronaphthalene	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
2-Chlorophenol	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
2-Methylnaphthalene	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
2-Nitroaniline	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
2-Nitrophenol	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
3,3'-Dichlorobenzidine	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
3-Nitroaniline	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
4,6-Dinitro-2-methylphenol	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
4-Bromophenyl phenyl ether	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS

AIR WATER SOIL LABORATORIES, INC.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-01 0-4' **Laboratory Sample ID:** 17H0710-03

Composite Start-End Date/Time: 08/21/2017 10:00 - 08/21/2017 10:00

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Semivolatile Organic Compounds by GCMS									
4-Chlorophenyl phenyl ether	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
4-Nitroaniline	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
4-Nitrophenol	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Acenaphthene	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Acenaphthylene	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Acetophenone	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Anthracene	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Atrazine	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Benzaldehyde	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Benzo (a) anthracene	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Benzo (a) pyrene	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Benzo (b) fluoranthene	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Benzo (g,h,i) perylene	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Benzo (k) fluoranthene	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
bis (2-Chloroethoxy) methane	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
bis (2-Chloroethyl) ether	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
2,2'-Oxybis (1-chloropropane)	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
bis (2-Ethylhexyl) phthalate	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Butyl benzyl phthalate	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Caprolactam	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Carbazole	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Chrysene	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Dibenz (a,h) anthracene	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Dibenzofuran	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Diethyl phthalate	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Dimethyl phthalate	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS

AIR WATER SOIL LABORATORIES, INC.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-01 0-4' **Laboratory Sample ID:** 17H0710-03

Composite Start-End Date/Time: 08/21/2017 10:00 - 08/21/2017 10:00

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Semivolatile Organic Compounds by GCMS									
Di-n-butyl phthalate	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Di-n-octyl phthalate	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Fluoranthene	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Fluorene	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Hexachlorobenzene	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Hexachlorobutadiene	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Hexachlorocyclopentadiene	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Hexachloroethane	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Indeno (1,2,3-cd) pyrene	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Isophorone	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
m+p-Cresols	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Naphthalene	03	SW8270D	<89.0 ug/kg		89.0	4	08/25/17 09:45	08/28/17 18:10	SKS
Nitrobenzene	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
n-Nitrosodi-n-propylamine	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
n-Nitrosodiphenylamine	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
o-Cresol	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
p-Chloro-m-cresol	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Pentachlorophenol	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Phenanthrene	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Phenol	03	SW8270D	<322 ug/kg		322	4	08/25/17 09:45	08/28/17 18:10	SKS
Surr: 2,4,6-Tribromophenol (Surr)	*03*	*SW8270D*	*56.9 %*		*35-125*		*08/25/17 09:45*	*08/28/17 18:10*	*SKS*
Surr: 2-Fluorobiphenyl (Surr)	*03*	*SW8270D*	*65.0 %*		*45-105*		*08/25/17 09:45*	*08/28/17 18:10*	*SKS*
Surr: 2-Fluorophenol (Surr)	*03*	*SW8270D*	*65.2 %*		*35-105*		*08/25/17 09:45*	*08/28/17 18:10*	*SKS*
Surr: Nitrobenzene-d5 (Surr)	*03*	*SW8270D*	*70.4 %*		*35-100*		*08/25/17 09:45*	*08/28/17 18:10*	*SKS*
Surr: Phenol-d5 (Surr)	*03*	*SW8270D*	*62.4 %*		*40-100*		*08/25/17 09:45*	*08/28/17 18:10*	*SKS*
Surr: p-Terphenyl-d14 (Surr)	*03*	*SW8270D*	*86.6 %*		*30-125*		*08/25/17 09:45*	*08/28/17 18:10*	*SKS*

AIR WATER SOIL LABORATORIES, INC.

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Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-01 0-4' **Laboratory Sample ID:** 17H0710-03

Composite Start-End Date/Time: 08/21/2017 10:00 - 08/21/2017 10:00

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Wet Chemistry Analysis									
Percent Solids	03	SM18 2540G	**89.9 %**		0.10	1	08/23/17 15:15	08/23/17 15:15	JCM

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Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-01 4-10' **Laboratory Sample ID:** 17H0710-04

Composite Start-End Date/Time: 08/21/2017 10:10 - 08/21/2017 10:10

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Metals (Total) by EPA 6000/7000 Series Methods									
Silver	04	SW6010C	<0.500 mg/kg		0.500	1	08/23/17 08:45	08/24/17 17:22	CWO
Aluminum	04RE1	SW6010C	**8220 mg/kg**		58.2	25	08/23/17 08:45	08/25/17 14:20	CWO
Arsenic	04	SW6010C	**20.6 mg/kg**		1.00	1	08/23/17 08:45	08/24/17 17:22	CWO
Barium	04	SW6010C	**48.8 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:22	CWO
Beryllium	04	SW6010C	<0.200 mg/kg		0.200	1	08/23/17 08:45	08/24/17 17:22	CWO
Calcium	04RE1	SW6010C	**12900 mg/kg**		1160	250	08/23/17 08:45	08/24/17 16:53	CWO
Cadmium	04	SW6010C	**1.14 mg/kg**		0.200	1	08/23/17 08:45	08/24/17 17:22	CWO
Cobalt	04	SW6010C	**8.62 mg/kg**		0.200	1	08/23/17 08:45	08/24/17 17:22	CWO
Chromium	04	SW6010C	**17.2 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:22	CWO
Copper	04	SW6010C	**16.1 mg/kg**		2.50	1	08/23/17 08:45	08/24/17 17:22	CWO
Iron	04RE1	SW6010C	**14000 mg/kg**		582	250	08/23/17 08:45	08/24/17 16:53	CWO
Mercury	04	SW7471B	**0.021 mg/kg**		0.008	1	08/23/17 13:17	08/28/17 12:11	MWL
Potassium	04	SW6010C	**870 mg/kg**		25.0	1	08/23/17 08:45	08/23/17 17:22	CWO
Magnesium	04RE1	SW6010C	**2980 mg/kg**		582	250	08/23/17 08:45	08/24/17 16:54	CWO
Manganese	04	SW6010C	**153 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:22	CWO
Sodium	04	SW6010C	**129 mg/kg**		25.0	1	08/23/17 08:45	08/23/17 17:22	CWO
Nickel	04	SW6010C	**10.9 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:22	CWO
Lead	04RE1	SW6010C	**18.3 mg/kg**		0.500	1	08/23/17 08:45	08/23/17 17:24	CWO
Antimony	04	SW6010C	<5.00 mg/kg		5.00	1	08/23/17 08:45	08/24/17 17:22	CWO
Selenium	04	SW6010C	<2.50 mg/kg		2.50	1	08/23/17 08:45	08/24/17 17:22	CWO
Thallium	04	SW6010C	<2.50 mg/kg		2.50	1	08/23/17 08:45	08/24/17 17:22	CWO
Vanadium	04	SW6010C	**23.7 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:22	CWO
Zinc	04	SW6010C	**40.5 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:22	CWO
Volatile Organic Compounds by GCMS									
1,1,1-Trichloroethane	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
1,1,2,2-Tetrachloroethane	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW

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Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-01 4-10' **Laboratory Sample ID:** 17H0710-04

Composite Start-End Date/Time: 08/21/2017 10:10 - 08/21/2017 10:10

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Volatile Organic Compounds by GCMS									
1,1,2-Trichloro-1,2,2-trifluoro ethane	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
1,1,2-Trichloroethane	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
1,1-Dichloroethane	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
1,1-Dichloroethylene	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
1,2,3-Trichlorobenzene	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
1,2,4-Trichlorobenzene	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
1,2-Dibromo-3-chloropropane (DBCP)	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
1,2-Dibromoethane (EDB)	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
1,2-Dichlorobenzene	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
1,2-Dichloroethane	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
1,2-Dichloropropane	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
1,3-Dichlorobenzene	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
1,4-Dichlorobenzene	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
1,4-Dioxane	04	SW8260B	<100 ug/kg		100	1	08/23/17 18:22	08/23/17 18:22	JDW
2-Butanone (MEK)	04	SW8260B	**5.91 ug/kg**		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
2-Hexanone (MBK)	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
4-Methyl-2-pentanone (MIBK)	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
Acetone	04	SW8260B	**48.7 ug/kg**		10.0	1	08/23/17 18:22	08/23/17 18:22	JDW
Benzene	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
Bromochloromethane	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
Bromodichloromethane	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
Bromoform	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
Bromomethane	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
Carbon disulfide	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
Chlorobenzene	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW

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Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-01 4-10' **Laboratory Sample ID:** 17H0710-04

Composite Start-End Date/Time: 08/21/2017 10:10 - 08/21/2017 10:10

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Volatile Organic Compounds by GCMS									
Chloroethane	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
Chloroform	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
Chloromethane	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
cis-1,2-Dichloroethylene	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
cis-1,3-Dichloropropene	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
Cyclohexane	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
Dibromochloromethane	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
Dichlorodifluoromethane	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
Ethylbenzene	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
Isopropylbenzene	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
m+p-Xylenes	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
Methyl acetate	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
Methyl cyclohexane	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
Methylene chloride	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
Methyl-t-butyl ether (MTBE)	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
o-Xylene	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
Styrene	04	SW8260B	<10.0 ug/kg		10.0	1	08/23/17 18:22	08/23/17 18:22	JDW
Tetrachloroethylene (PCE)	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
Toluene	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
trans-1,2-Dichloroethylene	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
trans-1,3-Dichloropropene	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
Trichloroethylene	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
Trichlorofluoromethane	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
Vinyl chloride	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW
Xylenes, Total	04	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:22	08/23/17 18:22	JDW

AIR WATER SOIL LABORATORIES, INC.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-01 4-10' **Laboratory Sample ID:** 17H0710-04

Composite Start-End Date/Time: 08/21/2017 10:10 - 08/21/2017 10:10

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Volatile Organic Compounds by GCMS									
Surr: 1,2-Dichloroethane-d4 (Surr)	*04*	*SW8260B*	*103 %*		*80-120*		*08/23/17 18:22*	*08/23/17 18:22*	*JDW*
Surr: 4-Bromofluorobenzene (Surr)	*04*	*SW8260B*	*99.7 %*		*85-120*		*08/23/17 18:22*	*08/23/17 18:22*	*JDW*
Surr: Dibromofluoromethane (Surr)	*04*	*SW8260B*	*102 %*		*78-119*		*08/23/17 18:22*	*08/23/17 18:22*	*JDW*
Surr: Toluene-d8 (Surr)	*04*	*SW8260B*	*105 %*		*85-115*		*08/23/17 18:22*	*08/23/17 18:22*	*JDW*
Semivolatile Organic Compounds by GCMS									
1,1-Biphenyl	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
1,2,4,5-Tetrachlorobenzene	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
2,3,4,6-Tetrachlorophenol	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
2,4,5-Trichlorophenol	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
2,4,6-Trichlorophenol	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
2,4-Dichlorophenol	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
2,4-Dimethylphenol	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
2,4-Dinitrophenol	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
2,4-Dinitrotoluene	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
2,6-Dinitrotoluene	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
2-Chloronaphthalene	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
2-Chlorophenol	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
2-Methylnaphthalene	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
2-Nitroaniline	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
2-Nitrophenol	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
3,3'-Dichlorobenzidine	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
3-Nitroaniline	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
4,6-Dinitro-2-methylphenol	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
4-Bromophenyl phenyl ether	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS

AIR WATER SOIL LABORATORIES, INC.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-01 4-10' **Laboratory Sample ID:** 17H0710-04

Composite Start-End Date/Time: 08/21/2017 10:10 - 08/21/2017 10:10

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Semivolatile Organic Compounds by GCMS									
4-Chlorophenyl phenyl ether	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
4-Nitroaniline	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
4-Nitrophenol	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Acenaphthene	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Acenaphthylene	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Acetophenone	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Anthracene	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Atrazine	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Benzaldehyde	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Benzo (a) anthracene	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Benzo (a) pyrene	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Benzo (b) fluoranthene	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Benzo (g,h,i) perylene	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Benzo (k) fluoranthene	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
bis (2-Chloroethoxy) methane	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
bis (2-Chloroethyl) ether	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
2,2'-Oxybis (1-chloropropane)	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
bis (2-Ethylhexyl) phthalate	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Butyl benzyl phthalate	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Caprolactam	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Carbazole	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Chrysene	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Dibenz (a,h) anthracene	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Dibenzofuran	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Diethyl phthalate	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Dimethyl phthalate	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS

AIR WATER SOIL LABORATORIES, INC.

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Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-01 4-10' **Laboratory Sample ID:** 17H0710-04

Composite Start-End Date/Time: 08/21/2017 10:10 - 08/21/2017 10:10

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Semivolatile Organic Compounds by GCMS									
Di-n-butyl phthalate	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Di-n-octyl phthalate	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Fluoranthene	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Fluorene	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Hexachlorobenzene	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Hexachlorobutadiene	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Hexachlorocyclopentadiene	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Hexachloroethane	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Indeno (1,2,3-cd) pyrene	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Isophorone	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
m+p-Cresols	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Naphthalene	04	SW8270D	<45.7 ug/kg		45.7	2	08/25/17 09:45	08/28/17 18:47	SKS
Nitrobenzene	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
n-Nitrosodi-n-propylamine	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
n-Nitrosodiphenylamine	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
o-Cresol	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
p-Chloro-m-cresol	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Pentachlorophenol	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Phenanthrene	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Phenol	04	SW8270D	<165 ug/kg		165	2	08/25/17 09:45	08/28/17 18:47	SKS
Surr: 2,4,6-Tribromophenol (Surr)	*04*	*SW8270D*	*63.4 %*		*35-125*		*08/25/17 09:45*	*08/28/17 18:47*	*SKS*
Surr: 2-Fluorobiphenyl (Surr)	*04*	*SW8270D*	*73.3 %*		*45-105*		*08/25/17 09:45*	*08/28/17 18:47*	*SKS*
Surr: 2-Fluorophenol (Surr)	*04*	*SW8270D*	*68.0 %*		*35-105*		*08/25/17 09:45*	*08/28/17 18:47*	*SKS*
Surr: Nitrobenzene-d5 (Surr)	*04*	*SW8270D*	*74.4 %*		*35-100*		*08/25/17 09:45*	*08/28/17 18:47*	*SKS*
Surr: Phenol-d5 (Surr)	*04*	*SW8270D*	*68.3 %*		*40-100*		*08/25/17 09:45*	*08/28/17 18:47*	*SKS*
Surr: p-Terphenyl-d14 (Surr)	*04*	*SW8270D*	*106 %*		*30-125*		*08/25/17 09:45*	*08/28/17 18:47*	*SKS*

AIR WATER SOIL LABORATORIES, INC.

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Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-01 4-10' **Laboratory Sample ID:** 17H0710-04

Composite Start-End Date/Time: 08/21/2017 10:10 - 08/21/2017 10:10

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Wet Chemistry Analysis									
Percent Solids	04	SM18 2540G	**83.6 %**		0.10	1	08/23/17 15:15	08/23/17 15:15	JCM

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Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-01 10-16' **Laboratory Sample ID:** 17H0710-05

Composite Start-End Date/Time: 08/21/2017 10:20 - 08/21/2017 10:20

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Metals (Total) by EPA 6000/7000 Series Methods									
Silver	05	SW6010C	<0.500 mg/kg		0.500	1	08/23/17 08:45	08/24/17 17:24	CWO
Aluminum	05RE1	SW6010C	**10400 mg/kg**		59.6	25	08/23/17 08:45	08/25/17 14:23	CWO
Arsenic	05	SW6010C	**5.99 mg/kg**		1.00	1	08/23/17 08:45	08/24/17 17:25	CWO
Barium	05	SW6010C	**70.4 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:24	CWO
Beryllium	05RE1	SW6010C	<0.381 mg/kg		0.381	2	08/23/17 08:45	08/25/17 15:53	CWO
Calcium	05	SW6010C	**434 mg/kg**		5.00	1	08/23/17 08:45	08/24/17 17:24	CWO
Cadmium	05	SW6010C	**1.49 mg/kg**		0.200	1	08/23/17 08:45	08/24/17 17:25	CWO
Cobalt	05	SW6010C	**9.80 mg/kg**		0.200	1	08/23/17 08:45	08/24/17 17:25	CWO
Chromium	05	SW6010C	**15.6 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:25	CWO
Copper	05	SW6010C	**10.7 mg/kg**		2.50	1	08/23/17 08:45	08/24/17 17:24	CWO
Iron	05RE1	SW6010C	**19400 mg/kg**		59.6	25	08/23/17 08:45	08/24/17 16:55	CWO
Mercury	05	SW7471B	**0.020 mg/kg**		0.008	1	08/23/17 13:17	08/28/17 12:14	MWL
Potassium	05	SW6010C	**768 mg/kg**		25.0	1	08/23/17 08:45	08/23/17 17:28	CWO
Magnesium	05RE1	SW6010C	**1390 mg/kg**		59.6	25	08/23/17 08:45	08/24/17 16:55	CWO
Manganese	05	SW6010C	**210 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:24	CWO
Sodium	05	SW6010C	**96.3 mg/kg**		25.0	1	08/23/17 08:45	08/23/17 17:28	CWO
Nickel	05	SW6010C	**12.0 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:25	CWO
Lead	05RE1	SW6010C	**8.07 mg/kg**		0.500	1	08/23/17 08:45	08/23/17 17:29	CWO
Antimony	05	SW6010C	<5.00 mg/kg		5.00	1	08/23/17 08:45	08/24/17 17:25	CWO
Selenium	05	SW6010C	<2.50 mg/kg		2.50	1	08/23/17 08:45	08/24/17 17:25	CWO
Thallium	05	SW6010C	<2.50 mg/kg		2.50	1	08/23/17 08:45	08/24/17 17:25	CWO
Vanadium	05	SW6010C	**24.7 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:24	CWO
Zinc	05	SW6010C	**36.4 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:24	CWO
Volatile Organic Compounds by GCMS									
1,1,1-Trichloroethane	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
1,1,2,2-Tetrachloroethane	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW

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Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-01 10-16' **Laboratory Sample ID:** 17H0710-05

Composite Start-End Date/Time: 08/21/2017 10:20 - 08/21/2017 10:20

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Volatile Organic Compounds by GCMS									
1,1,2-Trichloro-1,2,2-trifluoro ethane	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
1,1,2-Trichloroethane	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
1,1-Dichloroethane	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
1,1-Dichloroethylene	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
1,2,3-Trichlorobenzene	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
1,2,4-Trichlorobenzene	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
1,2-Dibromo-3-chloropropane (DBCP)	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
1,2-Dibromoethane (EDB)	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
1,2-Dichlorobenzene	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
1,2-Dichloroethane	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
1,2-Dichloropropane	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
1,3-Dichlorobenzene	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
1,4-Dichlorobenzene	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
1,4-Dioxane	05	SW8260B	<100 ug/kg		100	1	08/23/17 18:46	08/23/17 18:46	JDW
2-Butanone (MEK)	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
2-Hexanone (MBK)	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
4-Methyl-2-pentanone (MIBK)	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
Acetone	05	SW8260B	**11.1 ug/kg**		10.0	1	08/23/17 18:46	08/23/17 18:46	JDW
Benzene	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
Bromochloromethane	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
Bromodichloromethane	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
Bromoform	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
Bromomethane	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
Carbon disulfide	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
Chlorobenzene	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW

AIR WATER SOIL LABORATORIES, INC.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-01 10-16' **Laboratory Sample ID:** 17H0710-05

Composite Start-End Date/Time: 08/21/2017 10:20 - 08/21/2017 10:20

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Volatile Organic Compounds by GCMS									
Chloroethane	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
Chloroform	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
Chloromethane	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
cis-1,2-Dichloroethylene	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
cis-1,3-Dichloropropene	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
Cyclohexane	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
Dibromochloromethane	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
Dichlorodifluoromethane	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
Ethylbenzene	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
Isopropylbenzene	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
m+p-Xylenes	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
Methyl acetate	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
Methyl cyclohexane	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
Methylene chloride	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
Methyl-t-butyl ether (MTBE)	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
o-Xylene	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
Styrene	05	SW8260B	<10.0 ug/kg		10.0	1	08/23/17 18:46	08/23/17 18:46	JDW
Tetrachloroethylene (PCE)	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
Toluene	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
trans-1,2-Dichloroethylene	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
trans-1,3-Dichloropropene	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
Trichloroethylene	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
Trichlorofluoromethane	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
Vinyl chloride	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW
Xylenes, Total	05	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 18:46	08/23/17 18:46	JDW

AIR WATER SOIL LABORATORIES, INC.

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Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-01 10-16' **Laboratory Sample ID:** 17H0710-05

Composite Start-End Date/Time: 08/21/2017 10:20 - 08/21/2017 10:20

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Volatile Organic Compounds by GCMS									
Surr: 1,2-Dichloroethane-d4 (Surr)	*05*	*SW8260B*	*107 %*		*80-120*		*08/23/17 18:46*	*08/23/17 18:46*	*JDW*
Surr: 4-Bromofluorobenzene (Surr)	*05*	*SW8260B*	*101 %*		*85-120*		*08/23/17 18:46*	*08/23/17 18:46*	*JDW*
Surr: Dibromofluoromethane (Surr)	*05*	*SW8260B*	*105 %*		*78-119*		*08/23/17 18:46*	*08/23/17 18:46*	*JDW*
Surr: Toluene-d8 (Surr)	*05*	*SW8260B*	*105 %*		*85-115*		*08/23/17 18:46*	*08/23/17 18:46*	*JDW*
Semivolatile Organic Compounds by GCMS									
1,1-Biphenyl	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
1,2,4,5-Tetrachlorobenzene	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
2,3,4,6-Tetrachlorophenol	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
2,4,5-Trichlorophenol	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
2,4,6-Trichlorophenol	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
2,4-Dichlorophenol	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
2,4-Dimethylphenol	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
2,4-Dinitrophenol	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
2,4-Dinitrotoluene	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
2,6-Dinitrotoluene	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
2-Chloronaphthalene	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
2-Chlorophenol	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
2-Methylnaphthalene	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
2-Nitroaniline	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
2-Nitrophenol	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
3,3'-Dichlorobenzidine	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
3-Nitroaniline	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
4,6-Dinitro-2-methylphenol	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
4-Bromophenyl phenyl ether	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS

AIR WATER SOIL LABORATORIES, INC.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-01 10-16' **Laboratory Sample ID:** 17H0710-05

Composite Start-End Date/Time: 08/21/2017 10:20 - 08/21/2017 10:20

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Semivolatile Organic Compounds by GCMS									
4-Chlorophenyl phenyl ether	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
4-Nitroaniline	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
4-Nitrophenol	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Acenaphthene	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Acenaphthylene	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Acetophenone	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Anthracene	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Atrazine	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Benzaldehyde	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Benzo (a) anthracene	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Benzo (a) pyrene	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Benzo (b) fluoranthene	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Benzo (g,h,i) perylene	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Benzo (k) fluoranthene	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
bis (2-Chloroethoxy) methane	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
bis (2-Chloroethyl) ether	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
2,2'-Oxybis (1-chloropropane)	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
bis (2-Ethylhexyl) phthalate	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Butyl benzyl phthalate	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Caprolactam	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Carbazole	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Chrysene	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Dibenz (a,h) anthracene	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Dibenzofuran	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Diethyl phthalate	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Dimethyl phthalate	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS

AIR WATER SOIL LABORATORIES, INC.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-01 10-16' **Laboratory Sample ID:** 17H0710-05

Composite Start-End Date/Time: 08/21/2017 10:20 - 08/21/2017 10:20

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Semivolatile Organic Compounds by GCMS									
Di-n-butyl phthalate	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Di-n-octyl phthalate	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Fluoranthene	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Fluorene	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Hexachlorobenzene	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Hexachlorobutadiene	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Hexachlorocyclopentadiene	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Hexachloroethane	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Indeno (1,2,3-cd) pyrene	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Isophorone	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
m+p-Cresols	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Naphthalene	05	SW8270D	<23.0 ug/kg		23.0	1	08/25/17 09:45	08/28/17 19:23	SKS
Nitrobenzene	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
n-Nitrosodi-n-propylamine	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
n-Nitrosodiphenylamine	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
o-Cresol	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
p-Chloro-m-cresol	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Pentachlorophenol	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Phenanthrene	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Phenol	05	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:23	SKS
Surr: 2,4,6-Tribromophenol (Surr)	*05*	*SW8270D*	*59.6 %*		*35-125*		*08/25/17 09:45*	*08/28/17 19:23*	*SKS*
Surr: 2-Fluorobiphenyl (Surr)	*05*	*SW8270D*	*67.3 %*		*45-105*		*08/25/17 09:45*	*08/28/17 19:23*	*SKS*
Surr: 2-Fluorophenol (Surr)	*05*	*SW8270D*	*70.6 %*		*35-105*		*08/25/17 09:45*	*08/28/17 19:23*	*SKS*
Surr: Nitrobenzene-d5 (Surr)	*05*	*SW8270D*	*71.9 %*		*35-100*		*08/25/17 09:45*	*08/28/17 19:23*	*SKS*
Surr: Phenol-d5 (Surr)	*05*	*SW8270D*	*67.2 %*		*40-100*		*08/25/17 09:45*	*08/28/17 19:23*	*SKS*
Surr: p-Terphenyl-d14 (Surr)	*05*	*SW8270D*	*80.3 %*		*30-125*		*08/25/17 09:45*	*08/28/17 19:23*	*SKS*

AIR WATER & SOIL LABORATORIES, INC.

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Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-01 10-16' **Laboratory Sample ID:** 17H0710-05

Composite Start-End Date/Time: 08/21/2017 10:20 - 08/21/2017 10:20

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Wet Chemistry Analysis									
Percent Solids	05	SM18 2540G	**82.3 %**		0.10	1	08/23/17 15:15	08/23/17 15:15	JCM

AIR WATER SOIL LABORATORIES, INC.

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Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-02 0-6' **Laboratory Sample ID:** 17H0710-06

Composite Start-End Date/Time: 08/21/2017 11:40 - 08/21/2017 11:40

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Metals (Total) by EPA 6000/7000 Series Methods									
Silver	06	SW6010C	<0.500 mg/kg		0.500	1	08/23/17 08:45	08/24/17 17:36	CWO
Aluminum	06RE1	SW6010C	**8510 mg/kg**		60.3	25	08/23/17 08:45	08/25/17 14:27	CWO
Arsenic	06	SW6010C	**9.53 mg/kg**		1.00	1	08/23/17 08:45	08/24/17 17:36	CWO
Barium	06	SW6010C	**51.1 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:36	CWO
Beryllium	06	SW6010C	<0.200 mg/kg		0.200	1	08/23/17 08:45	08/24/17 17:36	CWO
Calcium	06RE1	SW6010C	**1210 mg/kg**		121	25	08/23/17 08:45	08/24/17 16:57	CWO
Cadmium	06	SW6010C	**0.952 mg/kg**		0.200	1	08/23/17 08:45	08/24/17 17:36	CWO
Cobalt	06	SW6010C	**11.8 mg/kg**		0.200	1	08/23/17 08:45	08/24/17 17:36	CWO
Chromium	06	SW6010C	**13.2 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:36	CWO
Copper	06	SW6010C	**9.55 mg/kg**		2.50	1	08/23/17 08:45	08/24/17 17:36	CWO
Iron	06RE1	SW6010C	**12200 mg/kg**		60.3	25	08/23/17 08:45	08/24/17 16:57	CWO
Mercury	06	SW7471B	**0.023 mg/kg**		0.008	1	08/23/17 13:17	08/28/17 12:17	MWL
Potassium	06	SW6010C	**705 mg/kg**		25.0	1	08/23/17 08:45	08/23/17 17:33	CWO
Magnesium	06RE1	SW6010C	**1100 mg/kg**		60.3	25	08/23/17 08:45	08/24/17 16:57	CWO
Manganese	06	SW6010C	**198 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:36	CWO
Sodium	06	SW6010C	**111 mg/kg**		25.0	1	08/23/17 08:45	08/23/17 17:33	CWO
Nickel	06	SW6010C	**9.07 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:36	CWO
Lead	06RE1	SW6010C	**11.9 mg/kg**		0.500	1	08/23/17 08:45	08/23/17 17:35	CWO
Antimony	06	SW6010C	<5.00 mg/kg		5.00	1	08/23/17 08:45	08/24/17 17:36	CWO
Selenium	06	SW6010C	<2.50 mg/kg		2.50	1	08/23/17 08:45	08/24/17 17:36	CWO
Thallium	06	SW6010C	<2.50 mg/kg		2.50	1	08/23/17 08:45	08/24/17 17:36	CWO
Vanadium	06	SW6010C	**20.9 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:36	CWO
Zinc	06	SW6010C	**31.1 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:36	CWO
Volatile Organic Compounds by GCMS									
1,1,1-Trichloroethane	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
1,1,2,2-Tetrachloroethane	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW

AIR WATER SOIL LABORATORIES, INC.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-02 0-6' **Laboratory Sample ID:** 17H0710-06

Composite Start-End Date/Time: 08/21/2017 11:40 - 08/21/2017 11:40

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Volatile Organic Compounds by GCMS									
1,1,2-Trichloro-1,2,2-trifluoro ethane	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
1,1,2-Trichloroethane	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
1,1-Dichloroethane	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
1,1-Dichloroethylene	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
1,2,3-Trichlorobenzene	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
1,2,4-Trichlorobenzene	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
1,2-Dibromo-3-chloropropane (DBCP)	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
1,2-Dibromoethane (EDB)	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
1,2-Dichlorobenzene	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
1,2-Dichloroethane	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
1,2-Dichloropropane	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
1,3-Dichlorobenzene	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
1,4-Dichlorobenzene	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
1,4-Dioxane	06	SW8260B	<100 ug/kg		100	1	08/23/17 19:09	08/23/17 19:09	JDW
2-Butanone (MEK)	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
2-Hexanone (MBK)	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
4-Methyl-2-pentanone (MIBK)	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
Acetone	06	SW8260B	<10.0 ug/kg		10.0	1	08/23/17 19:09	08/23/17 19:09	JDW
Benzene	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
Bromochloromethane	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
Bromodichloromethane	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
Bromoform	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
Bromomethane	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
Carbon disulfide	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
Chlorobenzene	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW

AIR WATER SOIL LABORATORIES, INC.

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Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-02 0-6' **Laboratory Sample ID:** 17H0710-06

Composite Start-End Date/Time: 08/21/2017 11:40 - 08/21/2017 11:40

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Volatile Organic Compounds by GCMS									
Chloroethane	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
Chloroform	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
Chloromethane	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
cis-1,2-Dichloroethylene	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
cis-1,3-Dichloropropene	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
Cyclohexane	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
Dibromochloromethane	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
Dichlorodifluoromethane	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
Ethylbenzene	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
Isopropylbenzene	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
m+p-Xylenes	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
Methyl acetate	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
Methyl cyclohexane	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
Methylene chloride	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
Methyl-t-butyl ether (MTBE)	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
o-Xylene	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
Styrene	06	SW8260B	<10.0 ug/kg		10.0	1	08/23/17 19:09	08/23/17 19:09	JDW
Tetrachloroethylene (PCE)	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
Toluene	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
trans-1,2-Dichloroethylene	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
trans-1,3-Dichloropropene	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
Trichloroethylene	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
Trichlorofluoromethane	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
Vinyl chloride	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW
Xylenes, Total	06	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:09	08/23/17 19:09	JDW

AIR WATER SOIL LABORATORIES, INC.

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Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-02 0-6' **Laboratory Sample ID:** 17H0710-06

Composite Start-End Date/Time: 08/21/2017 11:40 - 08/21/2017 11:40

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Volatile Organic Compounds by GCMS									
Surr: 1,2-Dichloroethane-d4 (Surr)	*06*	*SW8260B*	*107 %*		*80-120*		*08/23/17 19:09*	*08/23/17 19:09*	*JDW*
Surr: 4-Bromofluorobenzene (Surr)	*06*	*SW8260B*	*98.3 %*		*85-120*		*08/23/17 19:09*	*08/23/17 19:09*	*JDW*
Surr: Dibromofluoromethane (Surr)	*06*	*SW8260B*	*103 %*		*78-119*		*08/23/17 19:09*	*08/23/17 19:09*	*JDW*
Surr: Toluene-d8 (Surr)	*06*	*SW8260B*	*105 %*		*85-115*		*08/23/17 19:09*	*08/23/17 19:09*	*JDW*
Semivolatile Organic Compounds by GCMS									
1,1-Biphenyl	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
1,2,4,5-Tetrachlorobenzene	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
2,3,4,6-Tetrachlorophenol	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
2,4,5-Trichlorophenol	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
2,4,6-Trichlorophenol	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
2,4-Dichlorophenol	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
2,4-Dimethylphenol	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
2,4-Dinitrophenol	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
2,4-Dinitrotoluene	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
2,6-Dinitrotoluene	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
2-Chloronaphthalene	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
2-Chlorophenol	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
2-Methylnaphthalene	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
2-Nitroaniline	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
2-Nitrophenol	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
3,3'-Dichlorobenzidine	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
3-Nitroaniline	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
4,6-Dinitro-2-methylphenol	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
4-Bromophenyl phenyl ether	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS

AIR WATER SOIL LABORATORIES, INC.

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Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-02 0-6' **Laboratory Sample ID:** 17H0710-06

Composite Start-End Date/Time: 08/21/2017 11:40 - 08/21/2017 11:40

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Semivolatile Organic Compounds by GCMS									
4-Chlorophenyl phenyl ether	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
4-Nitroaniline	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
4-Nitrophenol	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Acenaphthene	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Acenaphthylene	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Acetophenone	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Anthracene	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Atrazine	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Benzaldehyde	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Benzo (a) anthracene	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Benzo (a) pyrene	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Benzo (b) fluoranthene	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Benzo (g,h,i) perylene	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Benzo (k) fluoranthene	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
bis (2-Chloroethoxy) methane	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
bis (2-Chloroethyl) ether	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
2,2'-Oxybis (1-chloropropane)	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
bis (2-Ethylhexyl) phthalate	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Butyl benzyl phthalate	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Caprolactam	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Carbazole	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Chrysene	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Dibenz (a,h) anthracene	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Dibenzofuran	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Diethyl phthalate	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Dimethyl phthalate	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS

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Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-02 0-6' **Laboratory Sample ID:** 17H0710-06

Composite Start-End Date/Time: 08/21/2017 11:40 - 08/21/2017 11:40

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Semivolatile Organic Compounds by GCMS									
Di-n-butyl phthalate	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Di-n-octyl phthalate	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Fluoranthene	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Fluorene	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Hexachlorobenzene	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Hexachlorobutadiene	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Hexachlorocyclopentadiene	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Hexachloroethane	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Indeno (1,2,3-cd) pyrene	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Isophorone	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
m+p-Cresols	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Naphthalene	06	SW8270D	<23.0 ug/kg		23.0	1	08/25/17 09:45	08/28/17 19:59	SKS
Nitrobenzene	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
n-Nitrosodi-n-propylamine	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
n-Nitrosodiphenylamine	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
o-Cresol	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
p-Chloro-m-cresol	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Pentachlorophenol	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Phenanthrene	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Phenol	06	SW8270D	<83.3 ug/kg		83.3	1	08/25/17 09:45	08/28/17 19:59	SKS
Surr: 2,4,6-Tribromophenol (Surr)	*06*	*SW8270D*	*66.0 %*		*35-125*		*08/25/17 09:45*	*08/28/17 19:59*	*SKS*
Surr: 2-Fluorobiphenyl (Surr)	*06*	*SW8270D*	*73.1 %*		*45-105*		*08/25/17 09:45*	*08/28/17 19:59*	*SKS*
Surr: 2-Fluorophenol (Surr)	*06*	*SW8270D*	*65.4 %*		*35-105*		*08/25/17 09:45*	*08/28/17 19:59*	*SKS*
Surr: Nitrobenzene-d5 (Surr)	*06*	*SW8270D*	*65.6 %*		*35-100*		*08/25/17 09:45*	*08/28/17 19:59*	*SKS*
Surr: Phenol-d5 (Surr)	*06*	*SW8270D*	*60.3 %*		*40-100*		*08/25/17 09:45*	*08/28/17 19:59*	*SKS*
Surr: p-Terphenyl-d14 (Surr)	*06*	*SW8270D*	*93.5 %*		*30-125*		*08/25/17 09:45*	*08/28/17 19:59*	*SKS*

AIR WATER SOIL LABORATORIES, INC.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-02 0-6' **Laboratory Sample ID:** 17H0710-06

Composite Start-End Date/Time: 08/21/2017 11:40 - 08/21/2017 11:40

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Wet Chemistry Analysis									
Percent Solids	06	SM18 2540G	**85.1 %**		0.10	1	08/23/17 15:15	08/23/17 15:15	JCM

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Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-04 0-4' **Laboratory Sample ID:** 17H0710-07

Composite Start-End Date/Time: 08/21/2017 12:45 - 08/21/2017 12:45

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Metals (Total) by EPA 6000/7000 Series Methods									
Silver	07	SW6010C	<0.500 mg/kg		0.500	1	08/23/17 08:45	08/24/17 17:39	CWO
Aluminum	07RE1	SW6010C	**8700 mg/kg**		466	200	08/23/17 08:45	08/25/17 14:31	CWO
Arsenic	07	SW6010C	**17.4 mg/kg**		1.00	1	08/23/17 08:45	08/24/17 17:39	CWO
Barium	07	SW6010C	**64.6 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:39	CWO
Beryllium	07RE1	SW6010C	<0.372 mg/kg		0.372	2	08/23/17 08:45	08/25/17 15:55	CWO
Calcium	07RE1	SW6010C	**34000 mg/kg**		931	200	08/23/17 08:45	08/25/17 14:31	CWO
Cadmium	07	SW6010C	**1.16 mg/kg**		0.200	1	08/23/17 08:45	08/24/17 17:39	CWO
Cobalt	07	SW6010C	**7.37 mg/kg**		0.200	1	08/23/17 08:45	08/24/17 17:39	CWO
Chromium	07	SW6010C	**33.9 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:39	CWO
Copper	07	SW6010C	**20.6 mg/kg**		2.50	1	08/23/17 08:45	08/24/17 17:39	CWO
Iron	07RE1	SW6010C	**14500 mg/kg**		466	200	08/23/17 08:45	08/25/17 14:31	CWO
Mercury	07	SW7471B	**0.020 mg/kg**		0.008	1	08/23/17 13:17	08/28/17 12:19	MWL
Potassium	07	SW6010C	**1220 mg/kg**		25.0	1	08/23/17 08:45	08/23/17 17:57	CWO
Magnesium	07RE1	SW6010C	**6430 mg/kg**		23.3	10	08/23/17 08:45	08/24/17 16:59	CWO
Manganese	07	SW6010C	**242 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:39	CWO
Sodium	07	SW6010C	**221 mg/kg**		25.0	1	08/23/17 08:45	08/23/17 17:57	CWO
Nickel	07	SW6010C	**11.2 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:39	CWO
Lead	07RE1	SW6010C	**13.5 mg/kg**		0.500	1	08/23/17 08:45	08/23/17 18:00	CWO
Antimony	07	SW6010C	<5.00 mg/kg		5.00	1	08/23/17 08:45	08/24/17 17:39	CWO
Selenium	07	SW6010C	<2.50 mg/kg		2.50	1	08/23/17 08:45	08/24/17 17:39	CWO
Thallium	07	SW6010C	**2.67 mg/kg**		2.50	1	08/23/17 08:45	08/24/17 17:39	CWO
Vanadium	07	SW6010C	**28.0 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:39	CWO
Zinc	07	SW6010C	**43.5 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:39	CWO
Volatile Organic Compounds by GCMS									
1,1,1-Trichloroethane	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
1,1,2,2-Tetrachloroethane	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW

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Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-04 0-4' **Laboratory Sample ID:** 17H0710-07

Composite Start-End Date/Time: 08/21/2017 12:45 - 08/21/2017 12:45

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Volatile Organic Compounds by GCMS									
1,1,2-Trichloro-1,2,2-trifluoro ethane	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
1,1,2-Trichloroethane	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
1,1-Dichloroethane	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
1,1-Dichloroethylene	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
1,2,3-Trichlorobenzene	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
1,2,4-Trichlorobenzene	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
1,2-Dibromo-3-chloropropane (DBCP)	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
1,2-Dibromoethane (EDB)	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
1,2-Dichlorobenzene	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
1,2-Dichloroethane	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
1,2-Dichloropropane	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
1,3-Dichlorobenzene	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
1,4-Dichlorobenzene	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
1,4-Dioxane	07	SW8260B	<100 ug/kg		100	1	08/23/17 19:33	08/23/17 19:33	JDW
2-Butanone (MEK)	07	SW8260B	**11.7 ug/kg**		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
2-Hexanone (MBK)	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
4-Methyl-2-pentanone (MIBK)	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
Acetone	07	SW8260B	**130 ug/kg**		10.0	1	08/23/17 19:33	08/23/17 19:33	JDW
Benzene	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
Bromochloromethane	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
Bromodichloromethane	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
Bromoform	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
Bromomethane	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
Carbon disulfide	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
Chlorobenzene	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW

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Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-04 0-4' **Laboratory Sample ID:** 17H0710-07

Composite Start-End Date/Time: 08/21/2017 12:45 - 08/21/2017 12:45

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Volatile Organic Compounds by GCMS									
Chloroethane	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
Chloroform	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
Chloromethane	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
cis-1,2-Dichloroethylene	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
cis-1,3-Dichloropropene	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
Cyclohexane	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
Dibromochloromethane	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
Dichlorodifluoromethane	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
Ethylbenzene	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
Isopropylbenzene	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
m+p-Xylenes	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
Methyl acetate	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
Methyl cyclohexane	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
Methylene chloride	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
Methyl-t-butyl ether (MTBE)	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
o-Xylene	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
Styrene	07	SW8260B	<10.0 ug/kg		10.0	1	08/23/17 19:33	08/23/17 19:33	JDW
Tetrachloroethylene (PCE)	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
Toluene	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
trans-1,2-Dichloroethylene	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
trans-1,3-Dichloropropene	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
Trichloroethylene	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
Trichlorofluoromethane	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
Vinyl chloride	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW
Xylenes, Total	07	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:33	08/23/17 19:33	JDW

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Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-04 0-4' **Laboratory Sample ID:** 17H0710-07

Composite Start-End Date/Time: 08/21/2017 12:45 - 08/21/2017 12:45

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Volatile Organic Compounds by GCMS									
Surr: 1,2-Dichloroethane-d4 (Surr)	*07*	*SW8260B*	*106 %*		*80-120*		*08/23/17 19:33*	*08/23/17 19:33*	*JDW*
Surr: 4-Bromofluorobenzene (Surr)	*07*	*SW8260B*	*100 %*		*85-120*		*08/23/17 19:33*	*08/23/17 19:33*	*JDW*
Surr: Dibromofluoromethane (Surr)	*07*	*SW8260B*	*71.1 %*	*S*	*78-119*		*08/23/17 19:33*	*08/23/17 19:33*	*JDW*
Surr: Toluene-d8 (Surr)	*07*	*SW8260B*	*104 %*		*85-115*		*08/23/17 19:33*	*08/23/17 19:33*	*JDW*
Semivolatile Organic Compounds by GCMS									
1,1-Biphenyl	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
1,2,4,5-Tetrachlorobenzene	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
2,3,4,6-Tetrachlorophenol	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
2,4,5-Trichlorophenol	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
2,4,6-Trichlorophenol	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
2,4-Dichlorophenol	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
2,4-Dimethylphenol	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
2,4-Dinitrophenol	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
2,4-Dinitrotoluene	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
2,6-Dinitrotoluene	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
2-Chloronaphthalene	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
2-Chlorophenol	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
2-Methylnaphthalene	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
2-Nitroaniline	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
2-Nitrophenol	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
3,3'-Dichlorobenzidine	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
3-Nitroaniline	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
4,6-Dinitro-2-methylphenol	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
4-Bromophenyl phenyl ether	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS

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Final Report

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Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-04 0-4' **Laboratory Sample ID:** 17H0710-07

Composite Start-End Date/Time: 08/21/2017 12:45 - 08/21/2017 12:45

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Semivolatile Organic Compounds by GCMS									
4-Chlorophenyl phenyl ether	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
4-Nitroaniline	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
4-Nitrophenol	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Acenaphthene	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Acenaphthylene	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Acetophenone	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Anthracene	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Atrazine	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Benzaldehyde	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Benzo (a) anthracene	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Benzo (a) pyrene	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Benzo (b) fluoranthene	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Benzo (g,h,i) perylene	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Benzo (k) fluoranthene	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
bis (2-Chloroethoxy) methane	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
bis (2-Chloroethyl) ether	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
2,2'-Oxybis (1-chloropropane)	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
bis (2-Ethylhexyl) phthalate	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Butyl benzyl phthalate	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Caprolactam	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Carbazole	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Chrysene	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Dibenz (a,h) anthracene	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Dibenzofuran	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Diethyl phthalate	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Dimethyl phthalate	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS

AIR WATER SOIL LABORATORIES, INC.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-04 0-4' **Laboratory Sample ID:** 17H0710-07

Composite Start-End Date/Time: 08/21/2017 12:45 - 08/21/2017 12:45

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Semivolatile Organic Compounds by GCMS									
Di-n-butyl phthalate	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Di-n-octyl phthalate	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Fluoranthene	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Fluorene	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Hexachlorobenzene	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Hexachlorobutadiene	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Hexachlorocyclopentadiene	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Hexachloroethane	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Indeno (1,2,3-cd) pyrene	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Isophorone	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
m+p-Cresols	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Naphthalene	07	SW8270D	<91.1 ug/kg		91.1	4	08/25/17 09:45	08/28/17 15:04	SKS
Nitrobenzene	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
n-Nitrosodi-n-propylamine	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
n-Nitrosodiphenylamine	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
o-Cresol	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
p-Chloro-m-cresol	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Pentachlorophenol	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Phenanthrene	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Phenol	07	SW8270D	<330 ug/kg		330	4	08/25/17 09:45	08/28/17 15:04	SKS
Surr: 2,4,6-Tribromophenol (Surr)	*07*	*SW8270D*	*4.40 %*	*DS*	*35-125*		*08/25/17 09:45*	*08/28/17 15:04*	*SKS*
Surr: 2-Fluorobiphenyl (Surr)	*07*	*SW8270D*	*70.2 %*		*45-105*		*08/25/17 09:45*	*08/28/17 15:04*	*SKS*
Surr: 2-Fluorophenol (Surr)	*07*	*SW8270D*	*26.5 %*	*DS*	*35-105*		*08/25/17 09:45*	*08/28/17 15:04*	*SKS*
Surr: Nitrobenzene-d5 (Surr)	*07*	*SW8270D*	*63.2 %*		*35-100*		*08/25/17 09:45*	*08/28/17 15:04*	*SKS*
Surr: Phenol-d5 (Surr)	*07*	*SW8270D*	*62.0 %*		*40-100*		*08/25/17 09:45*	*08/28/17 15:04*	*SKS*
Surr: p-Terphenyl-d14 (Surr)	*07*	*SW8270D*	*98.0 %*		*30-125*		*08/25/17 09:45*	*08/28/17 15:04*	*SKS*

AIR WATER & SOIL LABORATORIES, INC.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-04 0-4' **Laboratory Sample ID:** 17H0710-07

Composite Start-End Date/Time: 08/21/2017 12:45 - 08/21/2017 12:45

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Wet Chemistry Analysis									
Percent Solids	07	SM18 2540G	**90.9 %**		0.10	1	08/23/17 15:15	08/23/17 15:15	JCM

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Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-04 4-10' **Laboratory Sample ID:** 17H0710-08

Composite Start-End Date/Time: 08/21/2017 13:05 - 08/21/2017 13:05

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Metals (Total) by EPA 6000/7000 Series Methods									
Silver	08	SW6010C	<0.500 mg/kg		0.500	1	08/23/17 08:45	08/24/17 17:41	CWO
Aluminum	08RE1	SW6010C	**10900 mg/kg**		61.0	25	08/23/17 08:45	08/25/17 14:35	CWO
Arsenic	08	SW6010C	**23.8 mg/kg**		1.00	1	08/23/17 08:45	08/24/17 17:41	CWO
Barium	08	SW6010C	**81.3 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:41	CWO
Beryllium	08RE1	SW6010C	<0.391 mg/kg		0.391	2	08/23/17 08:45	08/25/17 16:02	CWO
Calcium	08RE1	SW6010C	**27200 mg/kg**		244	50	08/23/17 08:45	08/24/17 17:10	CWO
Cadmium	08	SW6010C	**1.53 mg/kg**		0.200	1	08/23/17 08:45	08/24/17 17:41	CWO
Cobalt	08	SW6010C	**10.8 mg/kg**		0.200	1	08/23/17 08:45	08/24/17 17:41	CWO
Chromium	08	SW6010C	**23.1 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:41	CWO
Copper	08	SW6010C	**30.6 mg/kg**		2.50	1	08/23/17 08:45	08/24/17 17:41	CWO
Iron	08RE1	SW6010C	**19100 mg/kg**		122	50	08/23/17 08:45	08/24/17 17:10	CWO
Mercury	08	SW7471B	**0.031 mg/kg**		0.008	1	08/23/17 13:17	08/28/17 12:22	MWL
Potassium	08	SW6010C	**1610 mg/kg**		25.0	1	08/23/17 08:45	08/23/17 18:03	CWO
Magnesium	08RE1	SW6010C	**5060 mg/kg**		122	50	08/23/17 08:45	08/24/17 17:10	CWO
Manganese	08	SW6010C	**278 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:41	CWO
Sodium	08	SW6010C	**257 mg/kg**		25.0	1	08/23/17 08:45	08/23/17 18:03	CWO
Nickel	08	SW6010C	**16.6 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:41	CWO
Lead	08RE1	SW6010C	**18.4 mg/kg**		0.500	1	08/23/17 08:45	08/23/17 18:05	CWO
Antimony	08	SW6010C	<5.00 mg/kg		5.00	1	08/23/17 08:45	08/24/17 17:41	CWO
Selenium	08	SW6010C	**3.39 mg/kg**		2.50	1	08/23/17 08:45	08/24/17 17:41	CWO
Thallium	08RE2	SW6010C	**2.88 mg/kg**		2.50	1	08/23/17 08:45	08/25/17 17:02	CWO
Vanadium	08	SW6010C	**37.4 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:41	CWO
Zinc	08	SW6010C	**55.7 mg/kg**		0.500	1	08/23/17 08:45	08/24/17 17:41	CWO
Volatile Organic Compounds by GCMS									
1,1,1-Trichloroethane	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
1,1,2,2-Tetrachloroethane	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW

AIR WATER SOIL LABORATORIES, INC.

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Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-04 4-10' **Laboratory Sample ID:** 17H0710-08

Composite Start-End Date/Time: 08/21/2017 13:05 - 08/21/2017 13:05

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Volatile Organic Compounds by GCMS									
1,1,2-Trichloro-1,2,2-trifluoro ethane	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
1,1,2-Trichloroethane	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
1,1-Dichloroethane	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
1,1-Dichloroethylene	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
1,2,3-Trichlorobenzene	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
1,2,4-Trichlorobenzene	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
1,2-Dibromo-3-chloropropane (DBCP)	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
1,2-Dibromoethane (EDB)	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
1,2-Dichlorobenzene	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
1,2-Dichloroethane	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
1,2-Dichloropropane	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
1,3-Dichlorobenzene	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
1,4-Dichlorobenzene	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
1,4-Dioxane	08	SW8260B	<100 ug/kg		100	1	08/23/17 19:56	08/23/17 19:56	JDW
2-Butanone (MEK)	08	SW8260B	**7.40 ug/kg**		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
2-Hexanone (MBK)	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
4-Methyl-2-pentanone (MIBK)	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
Acetone	08	SW8260B	**71.8 ug/kg**		10.0	1	08/23/17 19:56	08/23/17 19:56	JDW
Benzene	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
Bromochloromethane	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
Bromodichloromethane	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
Bromoform	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
Bromomethane	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
Carbon disulfide	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
Chlorobenzene	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW

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Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-04 4-10' **Laboratory Sample ID:** 17H0710-08

Composite Start-End Date/Time: 08/21/2017 13:05 - 08/21/2017 13:05

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Volatile Organic Compounds by GCMS									
Chloroethane	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
Chloroform	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
Chloromethane	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
cis-1,2-Dichloroethylene	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
cis-1,3-Dichloropropene	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
Cyclohexane	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
Dibromochloromethane	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
Dichlorodifluoromethane	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
Ethylbenzene	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
Isopropylbenzene	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
m+p-Xylenes	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
Methyl acetate	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
Methyl cyclohexane	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
Methylene chloride	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
Methyl-t-butyl ether (MTBE)	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
o-Xylene	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
Styrene	08	SW8260B	<10.0 ug/kg		10.0	1	08/23/17 19:56	08/23/17 19:56	JDW
Tetrachloroethylene (PCE)	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
Toluene	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
trans-1,2-Dichloroethylene	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
trans-1,3-Dichloropropene	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
Trichloroethylene	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
Trichlorofluoromethane	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
Vinyl chloride	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW
Xylenes, Total	08	SW8260B	<5.00 ug/kg		5.00	1	08/23/17 19:56	08/23/17 19:56	JDW

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Final Report

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Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-04 4-10' **Laboratory Sample ID:** 17H0710-08

Composite Start-End Date/Time: 08/21/2017 13:05 - 08/21/2017 13:05

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Volatile Organic Compounds by GCMS									
Surr: 1,2-Dichloroethane-d4 (Surr)	*08*	*SW8260B*	*105 %*		*80-120*		*08/23/17 19:56*	*08/23/17 19:56*	*JDW*
Surr: 4-Bromofluorobenzene (Surr)	*08*	*SW8260B*	*99.9 %*		*85-120*		*08/23/17 19:56*	*08/23/17 19:56*	*JDW*
Surr: Dibromofluoromethane (Surr)	*08*	*SW8260B*	*102 %*		*78-119*		*08/23/17 19:56*	*08/23/17 19:56*	*JDW*
Surr: Toluene-d8 (Surr)	*08*	*SW8260B*	*104 %*		*85-115*		*08/23/17 19:56*	*08/23/17 19:56*	*JDW*
Semivolatile Organic Compounds by GCMS									
1,1-Biphenyl	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
1,2,4,5-Tetrachlorobenzene	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
2,3,4,6-Tetrachlorophenol	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
2,4,5-Trichlorophenol	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
2,4,6-Trichlorophenol	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
2,4-Dichlorophenol	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
2,4-Dimethylphenol	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
2,4-Dinitrophenol	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
2,4-Dinitrotoluene	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
2,6-Dinitrotoluene	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
2-Chloronaphthalene	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
2-Chlorophenol	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
2-Methylnaphthalene	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
2-Nitroaniline	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
2-Nitrophenol	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
3,3'-Dichlorobenzidine	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
3-Nitroaniline	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
4,6-Dinitro-2-methylphenol	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
4-Bromophenyl phenyl ether	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS

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Final Report

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Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-04 4-10' **Laboratory Sample ID:** 17H0710-08

Composite Start-End Date/Time: 08/21/2017 13:05 - 08/21/2017 13:05

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Semivolatile Organic Compounds by GCMS									
4-Chlorophenyl phenyl ether	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
4-Nitroaniline	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
4-Nitrophenol	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Acenaphthene	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Acenaphthylene	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Acetophenone	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Anthracene	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Atrazine	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Benzaldehyde	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Benzo (a) anthracene	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Benzo (a) pyrene	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Benzo (b) fluoranthene	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Benzo (g,h,i) perylene	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Benzo (k) fluoranthene	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
bis (2-Chloroethoxy) methane	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
bis (2-Chloroethyl) ether	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
2,2'-Oxybis (1-chloropropane)	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
bis (2-Ethylhexyl) phthalate	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Butyl benzyl phthalate	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Caprolactam	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Carbazole	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Chrysene	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Dibenz (a,h) anthracene	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Dibenzofuran	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Diethyl phthalate	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Dimethyl phthalate	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS

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Client Site I.D.:	Four Mile Run	Purchase Order:	

Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-04 4-10' **Laboratory Sample ID:** 17H0710-08

Composite Start-End Date/Time: 08/21/2017 13:05 - 08/21/2017 13:05

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Semivolatile Organic Compounds by GCMS									
Di-n-butyl phthalate	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Di-n-octyl phthalate	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Fluoranthene	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Fluorene	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Hexachlorobenzene	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Hexachlorobutadiene	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Hexachlorocyclopentadiene	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Hexachloroethane	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Indeno (1,2,3-cd) pyrene	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Isophorone	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
m+p-Cresols	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Naphthalene	08	SW8270D	<40.8 ug/kg		40.8	2	08/25/17 09:45	08/28/17 20:35	SKS
Nitrobenzene	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
n-Nitrosodi-n-propylamine	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
n-Nitrosodiphenylamine	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
o-Cresol	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
p-Chloro-m-cresol	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Pentachlorophenol	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Phenanthrene	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Phenol	08	SW8270D	<148 ug/kg		148	2	08/25/17 09:45	08/28/17 20:35	SKS
Surr: 2,4,6-Tribromophenol (Surr)	*08*	*SW8270D*	*29.9 %*	*DS*	*35-125*		*08/25/17 09:45*	*08/28/17 20:35*	*SKS*
Surr: 2-Fluorobiphenyl (Surr)	*08*	*SW8270D*	*60.7 %*		*45-105*		*08/25/17 09:45*	*08/28/17 20:35*	*SKS*
Surr: 2-Fluorophenol (Surr)	*08*	*SW8270D*	*57.9 %*		*35-105*		*08/25/17 09:45*	*08/28/17 20:35*	*SKS*
Surr: Nitrobenzene-d5 (Surr)	*08*	*SW8270D*	*60.0 %*		*35-100*		*08/25/17 09:45*	*08/28/17 20:35*	*SKS*
Surr: Phenol-d5 (Surr)	*08*	*SW8270D*	*59.2 %*		*40-100*		*08/25/17 09:45*	*08/28/17 20:35*	*SKS*
Surr: p-Terphenyl-d14 (Surr)	*08*	*SW8270D*	*90.2 %*		*30-125*		*08/25/17 09:45*	*08/28/17 20:35*	*SKS*

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Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH-04 4-10' **Laboratory Sample ID:** 17H0710-08

Composite Start-End Date/Time: 08/21/2017 13:05 - 08/21/2017 13:05

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Wet Chemistry Analysis									
Percent Solids	08	SM18 2540G	**88.2 %**		0.10	1	08/23/17 15:15	08/23/17 15:15	JCM

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Laboratory Order ID: 17H0710

Analytical Results

Sample I.D. 17BH PCB Composite **Laboratory Sample ID:** 17H0710-09

Composite Start-End Date/Time: 08/21/2017 08:45 - 08/21/2017 13:05

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Organochlorine Pesticides and PCBs by GC/ECD									
PCB as Aroclor 1016	09	SW8082A	<0.115 mg/kg dry		0.115	1	08/25/17 13:55	08/28/17 12:37	LBH
PCB as Aroclor 1221	09	SW8082A	<0.115 mg/kg dry		0.115	1	08/25/17 13:55	08/28/17 12:37	LBH
PCB as Aroclor 1232	09	SW8082A	<0.115 mg/kg dry		0.115	1	08/25/17 13:55	08/28/17 12:37	LBH
PCB as Aroclor 1242	09	SW8082A	<0.115 mg/kg dry		0.115	1	08/25/17 13:55	08/28/17 12:37	LBH
PCB as Aroclor 1248	09	SW8082A	<0.115 mg/kg dry		0.115	1	08/25/17 13:55	08/28/17 12:37	LBH
PCB as Aroclor 1254	09	SW8082A	<0.115 mg/kg dry		0.115	1	08/25/17 13:55	08/28/17 12:37	LBH
PCB as Aroclor 1260	09	SW8082A	<0.115 mg/kg dry		0.115	1	08/25/17 13:55	08/28/17 12:37	LBH
Surr: DCB	*09*	*SW8082A*	*70.0 %*		*30-105*		*08/25/17 13:55*	*08/28/17 12:37*	*LBH*
Surr: TCMX	*09*	*SW8082A*	*85.0 %*		*30-105*		*08/25/17 13:55*	*08/28/17 12:37*	*LBH*
Wet Chemistry Analysis									
Percent Solids	09	SM18 2540G	**87.0 %**		0.10	1	08/23/17 15:15	08/23/17 15:15	JCM

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Analytical Summary

Preparation Method:

Preparation Method:

Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID
Wet Chemistry Analysis		**Preparation Method:**	**No Prep Wet Chem**		
17H0710-01	1.00 g / 1.00 mL	SM18 2540G	BAH0706	SAH0694	
17H0710-02	1.00 g / 1.00 mL	SM18 2540G	BAH0706	SAH0694	
17H0710-03	1.00 g / 1.00 mL	SM18 2540G	BAH0706	SAH0694	
17H0710-04	1.00 g / 1.00 mL	SM18 2540G	BAH0706	SAH0694	
17H0710-05	1.00 g / 1.00 mL	SM18 2540G	BAH0706	SAH0694	
17H0710-06	1.00 g / 1.00 mL	SM18 2540G	BAH0706	SAH0694	
17H0710-07	1.00 g / 1.00 mL	SM18 2540G	BAH0706	SAH0694	
17H0710-08	1.00 g / 1.00 mL	SM18 2540G	BAH0706	SAH0694	
17H0710-09	1.00 g / 1.00 mL	SM18 2540G	BAH0706	SAH0694	

Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID
Metals (Total) by EPA 6000/7000 Series Methods		**Preparation Method:**	**SW3050B**		
17H0710-01	1.00 g / 50.0 mL	SW6010C	BAH0682	SAH0682	AH70128
17H0710-01	1.00 g / 50.0 mL	SW6010C	BAH0682	SAH0720	AH70132
17H0710-01RE1	1.00 g / 50.0 mL	SW6010C	BAH0682	SAH0682	AH70128
17H0710-01RE1	1.00 g / 50.0 mL	SW6010C	BAH0682	SAH0720	AH70132
17H0710-01RE1	1.00 g / 50.0 mL	SW6010C	BAH0682	SAH0775	AH70148
17H0710-02	1.09 g / 50.0 mL	SW6010C	BAH0682	SAH0682	AH70128
17H0710-02	1.09 g / 50.0 mL	SW6010C	BAH0682	SAH0720	AH70132
17H0710-02RE1	1.09 g / 50.0 mL	SW6010C	BAH0682	SAH0682	AH70128
17H0710-02RE1	1.09 g / 50.0 mL	SW6010C	BAH0682	SAH0720	AH70132
17H0710-02RE1	1.09 g / 50.0 mL	SW6010C	BAH0682	SAH0764	AH70143
17H0710-02RE1	1.09 g / 50.0 mL	SW6010C	BAH0682	SAH0775	AH70148
17H0710-03	1.03 g / 50.0 mL	SW6010C	BAH0682	SAH0682	AH70128
17H0710-03	1.03 g / 50.0 mL	SW6010C	BAH0682	SAH0720	AH70132
17H0710-03RE1	1.03 g / 50.0 mL	SW6010C	BAH0682	SAH0682	AH70128
17H0710-03RE1	1.03 g / 50.0 mL	SW6010C	BAH0682	SAH0720	AH70132
17H0710-03RE1	1.03 g / 50.0 mL	SW6010C	BAH0682	SAH0775	AH70148
17H0710-04	1.07 g / 50.0 mL	SW6010C	BAH0682	SAH0682	AH70128

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Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID
17H0710-04	1.07 g / 50.0 mL	SW6010C	BAH0682	SAH0720	AH70132
17H0710-04RE1	1.07 g / 50.0 mL	SW6010C	BAH0682	SAH0682	AH70128
17H0710-04RE1	1.07 g / 50.0 mL	SW6010C	BAH0682	SAH0720	AH70132
17H0710-04RE1	1.07 g / 50.0 mL	SW6010C	BAH0682	SAH0775	AH70148
17H0710-05	1.05 g / 50.0 mL	SW6010C	BAH0682	SAH0682	AH70128
17H0710-05	1.05 g / 50.0 mL	SW6010C	BAH0682	SAH0720	AH70132
17H0710-05RE1	1.05 g / 50.0 mL	SW6010C	BAH0682	SAH0682	AH70128
17H0710-05RE1	1.05 g / 50.0 mL	SW6010C	BAH0682	SAH0720	AH70132
17H0710-05RE1	1.05 g / 50.0 mL	SW6010C	BAH0682	SAH0764	AH70143
17H0710-05RE1	1.05 g / 50.0 mL	SW6010C	BAH0682	SAH0775	AH70148
17H0710-06	1.04 g / 50.0 mL	SW6010C	BAH0682	SAH0682	AH70128
17H0710-06	1.04 g / 50.0 mL	SW6010C	BAH0682	SAH0720	AH70132
17H0710-06RE1	1.04 g / 50.0 mL	SW6010C	BAH0682	SAH0682	AH70128
17H0710-06RE1	1.04 g / 50.0 mL	SW6010C	BAH0682	SAH0720	AH70132
17H0710-06RE1	1.04 g / 50.0 mL	SW6010C	BAH0682	SAH0775	AH70148
17H0710-07	1.07 g / 50.0 mL	SW6010C	BAH0682	SAH0682	AH70128
17H0710-07	1.07 g / 50.0 mL	SW6010C	BAH0682	SAH0720	AH70132
17H0710-07RE1	1.07 g / 50.0 mL	SW6010C	BAH0682	SAH0682	AH70128
17H0710-07RE1	1.07 g / 50.0 mL	SW6010C	BAH0682	SAH0720	AH70132
17H0710-07RE1	1.07 g / 50.0 mL	SW6010C	BAH0682	SAH0764	AH70143
17H0710-07RE1	1.07 g / 50.0 mL	SW6010C	BAH0682	SAH0775	AH70148
17H0710-08	1.02 g / 50.0 mL	SW6010C	BAH0682	SAH0682	AH70128
17H0710-08	1.02 g / 50.0 mL	SW6010C	BAH0682	SAH0720	AH70132
17H0710-08RE1	1.02 g / 50.0 mL	SW6010C	BAH0682	SAH0682	AH70128
17H0710-08RE1	1.02 g / 50.0 mL	SW6010C	BAH0682	SAH0720	AH70132
17H0710-08RE1	1.02 g / 50.0 mL	SW6010C	BAH0682	SAH0764	AH70143
17H0710-08RE1	1.02 g / 50.0 mL	SW6010C	BAH0682	SAH0775	AH70148
17H0710-08RE2	1.02 g / 50.0 mL	SW6010C	BAH0682	SAH0764	AH70143

Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID
Organochlorine Pesticides and PCBs by GC/ECD		**Preparation Method:**	**SW3550B**		
17H0710-09	30.0 g / 5.00 mL	SW8082A	BAH0795	SAH0812	AG70131

Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID

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Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID
Semivolatile Organic Compounds by GCMS		**Preparation Method:**	**SW3550C**		
17H0710-01	30.2 g / 1.00 mL	SW8270D	BAH0783	SAH0784	AH70133
17H0710-02	30.8 g / 1.00 mL	SW8270D	BAH0783	SAH0784	AH70133
17H0710-03	31.0 g / 1.00 mL	SW8270D	BAH0783	SAH0784	AH70133
17H0710-04	30.2 g / 1.00 mL	SW8270D	BAH0783	SAH0784	AH70133
17H0710-05	33.2 g / 1.00 mL	SW8270D	BAH0783	SAH0784	AH70133
17H0710-06	31.5 g / 1.00 mL	SW8270D	BAH0783	SAH0784	AH70133
17H0710-07	30.3 g / 1.00 mL	SW8270D	BAH0783	SAH0784	AH70133
17H0710-08	33.8 g / 1.00 mL	SW8270D	BAH0783	SAH0784	AH70133

Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID
Volatile Organic Compounds by GCMS		**Preparation Method:**	**SW5030B**		
17H0710-01	5.01 g / 5.00 mL	SW8260B	BAH0737	SAH0722	AH70076
17H0710-02	5.08 g / 5.00 mL	SW8260B	BAH0737	SAH0722	AH70076
17H0710-03	5.03 g / 5.00 mL	SW8260B	BAH0737	SAH0722	AH70076
17H0710-04	5.08 g / 5.00 mL	SW8260B	BAH0737	SAH0722	AH70076
17H0710-05	5.09 g / 5.00 mL	SW8260B	BAH0737	SAH0722	AH70076
17H0710-06	5.03 g / 5.00 mL	SW8260B	BAH0737	SAH0722	AH70076
17H0710-07	5.01 g / 5.00 mL	SW8260B	BAH0737	SAH0722	AH70076
17H0710-08	5.01 g / 5.00 mL	SW8260B	BAH0737	SAH0722	AH70076

Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID
Metals (Total) by EPA 6000/7000 Series Methods		**Preparation Method:**	**SW7471B**		
17H0710-01	0.517 g / 20.0 mL	SW7471B	BAH0695	SAH0795	AH70151
17H0710-02	0.504 g / 20.0 mL	SW7471B	BAH0695	SAH0795	AH70151
17H0710-03	0.523 g / 20.0 mL	SW7471B	BAH0695	SAH0795	AH70151
17H0710-04	0.537 g / 20.0 mL	SW7471B	BAH0695	SAH0795	AH70151
17H0710-05	0.516 g / 20.0 mL	SW7471B	BAH0695	SAH0795	AH70151
17H0710-06	0.528 g / 20.0 mL	SW7471B	BAH0695	SAH0795	AH70151
17H0710-07	0.532 g / 20.0 mL	SW7471B	BAH0695	SAH0795	AH70151
17H0710-08	0.501 g / 20.0 mL	SW7471B	BAH0695	SAH0795	AH70151

AIR WATER & SOIL LABORATORIES, INC.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Metals (Total) by EPA 6000/7000 Series Methods - Quality Control

Air Water and Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BAH0682 - SW3050B										
Blank (BAH0682-BLK1)				Prepared: 08/23/2017 Analyzed: 08/24/2017						
Magnesium	<2.50 mg/kg	2.50	mg/kg							
Beryllium	<0.200 mg/kg	0.200	mg/kg							
Calcium	5.10 mg/kg	5.00	mg/kg							B
Cadmium	<0.200 mg/kg	0.200	mg/kg							
Cobalt	<0.200 mg/kg	0.200	mg/kg							
Chromium	<0.500 mg/kg	0.500	mg/kg							
Barium	<0.500 mg/kg	0.500	mg/kg							
Copper	<2.50 mg/kg	2.50	mg/kg							
Arsenic	<1.00 mg/kg	1.00	mg/kg							
Iron	4.27 mg/kg	2.50	mg/kg							B
Silver	<0.500 mg/kg	0.500	mg/kg							
Manganese	<0.500 mg/kg	0.500	mg/kg							
Nickel	<0.500 mg/kg	0.500	mg/kg							
Selenium	<2.50 mg/kg	2.50	mg/kg							
Zinc	<0.500 mg/kg	0.500	mg/kg							
Vanadium	<0.500 mg/kg	0.500	mg/kg							
Thallium	<2.50 mg/kg	2.50	mg/kg							
Antimony	<5.00 mg/kg	5.00	mg/kg							
Blank (BAH0682-BLK2)				Prepared & Analyzed: 08/23/2017						
Lead	<0.500 mg/kg	0.500	mg/kg							
Aluminum	<2.50 mg/kg	2.50	mg/kg							
Potassium	<25.0 mg/kg	25.0	mg/kg							
Sodium	<25.0 mg/kg	25.0	mg/kg							
LCS (BAH0682-BS1)				Prepared: 08/23/2017 Analyzed: 08/24/2017						
Selenium	85.7 mg/kg	2.50	mg/kg	94.7	mg/kg	90.5	80-120			
Barium	102 mg/kg	0.500	mg/kg	94.7	mg/kg	108	80-120			
Zinc	92.9 mg/kg	0.500	mg/kg	94.7	mg/kg	98.1	80-120			
Beryllium	97.4 mg/kg	0.200	mg/kg	94.7	mg/kg	103	80-120			
Calcium	106 mg/kg	5.00	mg/kg	94.7	mg/kg	112	80-120			
Vanadium	102 mg/kg	0.500	mg/kg	94.7	mg/kg	108	80-120			

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Metals (Total) by EPA 6000/7000 Series Methods - Quality Control

Air Water and Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BAH0682 - SW3050B										
LCS (BAH0682-BS1)				Prepared: 08/23/2017 Analyzed: 08/24/2017						
Copper	104 mg/kg	2.50	mg/kg	94.7	mg/kg	110	80-120			
Chromium	102 mg/kg	0.500	mg/kg	94.7	mg/kg	107	80-120			
Lead	99.4 mg/kg	0.500	mg/kg	94.7	mg/kg	105	80-120			
Manganese	102 mg/kg	0.500	mg/kg	94.7	mg/kg	108	80-120			
Nickel	99.5 mg/kg	0.500	mg/kg	94.7	mg/kg	105	80-120			
Antimony	94.6 mg/kg	5.00	mg/kg	94.7	mg/kg	99.9	80-120			
Iron	104 mg/kg	2.50	mg/kg	94.7	mg/kg	110	80-120			
Arsenic	92.3 mg/kg	1.00	mg/kg	94.7	mg/kg	97.5	80-120			
Magnesium	98.1 mg/kg	2.50	mg/kg	94.7	mg/kg	104	80-120			
Thallium	91.2 mg/kg	2.50	mg/kg	94.7	mg/kg	96.3	80-120			
Cadmium	96.4 mg/kg	0.200	mg/kg	94.7	mg/kg	102	80-120			
Silver	5.00 mg/kg	0.500	mg/kg	4.73	mg/kg	106	80-120			
Cobalt	99.3 mg/kg	0.200	mg/kg	94.7	mg/kg	105	80-120			
LCS (BAH0682-BS2)				Prepared & Analyzed: 08/23/2017						
Iron	98.7 mg/kg	2.50	mg/kg	94.7	mg/kg	104	80-120			
Potassium	248 mg/kg	25.0	mg/kg	237	mg/kg	105	80-120			
Sodium	247 mg/kg	25.0	mg/kg	237	mg/kg	104	80-120			
Lead	95.3 mg/kg	0.500	mg/kg	94.7	mg/kg	101	80-120			
Aluminum	99.3 mg/kg	2.50	mg/kg	94.7	mg/kg	105	80-120			
LCS Dup (BAH0682-BSD1)				Prepared: 08/23/2017 Analyzed: 08/24/2017						
Magnesium	101 mg/kg	2.50	mg/kg	98.4	mg/kg	103	80-120	2.95	20	
Manganese	105 mg/kg	0.500	mg/kg	98.4	mg/kg	107	80-120	2.83	20	
Vanadium	105 mg/kg	0.500	mg/kg	98.4	mg/kg	106	80-120	2.76	20	
Chromium	105 mg/kg	0.500	mg/kg	98.4	mg/kg	107	80-120	3.10	20	
Copper	107 mg/kg	2.50	mg/kg	98.4	mg/kg	109	80-120	2.83	20	
Iron	108 mg/kg	2.50	mg/kg	98.4	mg/kg	110	80-120	3.54	20	
Antimony	96.8 mg/kg	5.00	mg/kg	98.4	mg/kg	98.4	80-120	2.35	20	
Nickel	103 mg/kg	0.500	mg/kg	98.4	mg/kg	104	80-120	3.12	20	
Lead	99.3 mg/kg	0.500	mg/kg	98.4	mg/kg	101	80-120	0.127	20	
Zinc	96.1 mg/kg	0.500	mg/kg	98.4	mg/kg	97.6	80-120	3.31	20	

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Client Site I.D.:	Four Mile Run	Purchase Order:	

Metals (Total) by EPA 6000/7000 Series Methods - Quality Control

Air Water and Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BAH0682 - SW3050B										
LCS Dup (BAH0682-BSD1)				Prepared: 08/23/2017 Analyzed: 08/24/2017						
Silver	5.24 mg/kg	0.500	mg/kg	4.92	mg/kg	106	80-120	4.63	20	
Beryllium	101 mg/kg	0.200	mg/kg	98.4	mg/kg	102	80-120	3.31	20	
Selenium	88.0 mg/kg	2.50	mg/kg	98.4	mg/kg	89.4	80-120	2.67	20	
Cobalt	102 mg/kg	0.200	mg/kg	98.4	mg/kg	104	80-120	3.09	20	
Calcium	110 mg/kg	5.00	mg/kg	98.4	mg/kg	111	80-120	3.12	20	
Thallium	95.1 mg/kg	2.50	mg/kg	98.4	mg/kg	96.6	80-120	4.19	20	
Arsenic	93.8 mg/kg	1.00	mg/kg	98.4	mg/kg	95.3	80-120	1.60	20	
Cadmium	99.6 mg/kg	0.200	mg/kg	98.4	mg/kg	101	80-120	3.31	20	
Barium	106 mg/kg	0.500	mg/kg	98.4	mg/kg	107	80-120	2.95	20	
LCS Dup (BAH0682-BSD2)				Prepared & Analyzed: 08/23/2017						
Iron	102 mg/kg	2.50	mg/kg	98.4	mg/kg	103	80-120	3.02	20	
Potassium	257 mg/kg	25.0	mg/kg	246	mg/kg	104	80-120	3.62	20	
Aluminum	104 mg/kg	2.50	mg/kg	98.4	mg/kg	106	80-120	4.96	20	
Sodium	258 mg/kg	25.0	mg/kg	246	mg/kg	105	80-120	4.13	20	
Lead	96.4 mg/kg	0.500	mg/kg	98.4	mg/kg	98.0	80-120	1.12	20	
Matrix Spike (BAH0682-MS1)		**Source: 17H0710-01**		Prepared: 08/23/2017 Analyzed: 08/24/2017						
Thallium	86.5 mg/kg	2.50	mg/kg	99.4	<2.50 mg/kg	87.0	75-125			
Selenium	82.4 mg/kg	2.50	mg/kg	99.4	<2.50 mg/kg	82.9	75-125			
Lead	118 mg/kg	0.500	mg/kg	99.4	21.7 mg/kg	97.0	75-125			
Nickel	113 mg/kg	0.500	mg/kg	99.4	28.6 mg/kg	85.3	75-125			
Manganese	551 mg/kg	0.500	mg/kg	99.4	559 mg/kg	-8.23	75-125			M
Magnesium	4290 mg/kg	2.50	mg/kg	99.4	4240 mg/kg	51.6	75-125			M, E
Iron	23100 mg/kg	2.50	mg/kg	99.4	18800 mg/kg	4290	75-125			M, E
Copper	140 mg/kg	2.50	mg/kg	99.4	38.6 mg/kg	102	75-125			
Antimony	18.6 mg/kg	5.00	mg/kg	99.4	<5.00 mg/kg	18.7	75-125			M
Calcium	2800 mg/kg	5.00	mg/kg	99.4	2640 mg/kg	166	75-125			M, E
Silver	5.21 mg/kg	0.500	mg/kg	4.97	<0.500 mg/kg	105	75-125			
Arsenic	128 mg/kg	1.00	mg/kg	99.4	25.9 mg/kg	103	75-125			
Cobalt	110 mg/kg	0.200	mg/kg	99.4	18.5 mg/kg	91.6	75-125			
Barium	186 mg/kg	0.500	mg/kg	99.4	91.9 mg/kg	95.2	75-125			

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Client Site I.D.:	Four Mile Run	Purchase Order:	

Metals (Total) by EPA 6000/7000 Series Methods - Quality Control

Air Water and Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BAH0682 - SW3050B										
Matrix Spike (BAH0682-MS1)	**Source: 17H0710-01**			Prepared: 08/23/2017 Analyzed: 08/24/2017						
Chromium	135 mg/kg	0.500	mg/kg	99.4	35.0 mg/kg	100	75-125			
Beryllium	95.2 mg/kg	0.200	mg/kg	99.4	<0.200 mg/kg	95.7	75-125			
Zinc	150 mg/kg	0.500	mg/kg	99.4	57.9 mg/kg	92.4	75-125			
Cadmium	94.3 mg/kg	0.200	mg/kg	99.4	2.24 mg/kg	92.7	75-125			
Vanadium	168 mg/kg	0.500	mg/kg	99.4	72.3 mg/kg	96.2	75-125			
Matrix Spike (BAH0682-MS2)	**Source: 17H0710-01**			Prepared & Analyzed: 08/23/2017						
Aluminum	90400 mg/kg	12.4	mg/kg	99.4	15700 mg/kg	75100	75-125			M2, E
Iron	96400 mg/kg	12.4	mg/kg	99.4	18800 mg/kg	78000	75-125			M2, E
Potassium	15100 mg/kg	124	mg/kg	249	2900 mg/kg	4910	75-125			M2
Lead	570 mg/kg	2.49	mg/kg	99.4	21.7 mg/kg	552	75-125			M2
Sodium	1730 mg/kg	124	mg/kg	249	<124 mg/kg	697	75-125			M2
Matrix Spike Dup (BAH0682-MSD1)	**Source: 17H0710-01**			Prepared: 08/23/2017 Analyzed: 08/24/2017						
Manganese	483 mg/kg	0.500	mg/kg	95.5	559 mg/kg	-79.6	75-125	13.1	20	M
Thallium	88.2 mg/kg	2.50	mg/kg	95.5	<2.50 mg/kg	92.4	75-125	1.97	20	
Nickel	115 mg/kg	0.500	mg/kg	95.5	28.6 mg/kg	90.1	75-125	1.04	20	
Zinc	154 mg/kg	0.500	mg/kg	95.5	57.9 mg/kg	100	75-125	2.47	20	
Lead	124 mg/kg	0.500	mg/kg	95.5	21.7 mg/kg	107	75-125	4.60	20	
Iron	21500 mg/kg	2.50	mg/kg	95.5	18800 mg/kg	2780	75-125	7.24	20	M, E
Cadmium	94.3 mg/kg	0.200	mg/kg	95.5	2.24 mg/kg	96.4	75-125	0.0454	20	
Beryllium	95.9 mg/kg	0.200	mg/kg	95.5	<0.200 mg/kg	100	75-125	0.739	20	
Cobalt	110 mg/kg	0.200	mg/kg	95.5	18.5 mg/kg	95.3	75-125	0.0190	20	
Barium	179 mg/kg	0.500	mg/kg	95.5	91.9 mg/kg	91.6	75-125	3.88	20	
Arsenic	144 mg/kg	1.00	mg/kg	95.5	25.9 mg/kg	123	75-125	11.5	20	
Calcium	3090 mg/kg	5.00	mg/kg	95.5	2640 mg/kg	475	75-125	9.78	20	M, E
Silver	5.19 mg/kg	0.500	mg/kg	4.78	<0.500 mg/kg	109	75-125	0.301	20	
Magnesium	3960 mg/kg	2.50	mg/kg	95.5	4240 mg/kg	-285	75-125	7.84	20	M, E
Chromium	133 mg/kg	0.500	mg/kg	95.5	35.0 mg/kg	102	75-125	1.48	20	
Selenium	83.0 mg/kg	2.50	mg/kg	95.5	<2.50 mg/kg	86.9	75-125	0.680	20	
Vanadium	163 mg/kg	0.500	mg/kg	95.5	72.3 mg/kg	95.1	75-125	2.89	20	
Antimony	19.1 mg/kg	5.00	mg/kg	95.5	<5.00 mg/kg	20.0	75-125	2.63	20	M

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Metals (Total) by EPA 6000/7000 Series Methods - Quality Control

Air Water and Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BAH0682 - SW3050B										
Matrix Spike Dup (BAH0682-MSD1)	**Source: 17H0710-01**			Prepared: 08/23/2017 Analyzed: 08/24/2017						
Copper	148 mg/kg	2.50	mg/kg	95.5	38.6 mg/kg	115	75-125	5.60	20	
Matrix Spike Dup (BAH0682-MSD2)	**Source: 17H0710-01**			Prepared & Analyzed: 08/23/2017						
Potassium	12900 mg/kg	119	mg/kg	239	2900 mg/kg	4210	75-125	15.3	20	M2
Iron	90900 mg/kg	11.9	mg/kg	95.5	18800 mg/kg	75500	75-125	5.82	20	M2, E
Aluminum	85900 mg/kg	11.9	mg/kg	95.5	15700 mg/kg	73500	75-125	5.04	20	M2, E
Sodium	2190 mg/kg	119	mg/kg	239	<119 mg/kg	919	75-125	23.5	20	M2, P
Lead	605 mg/kg	2.39	mg/kg	95.5	21.7 mg/kg	611	75-125	5.97	20	M2
Batch BAH0695 - SW7471B										
Blank (BAH0695-BLK1)				Prepared: 08/23/2017 Analyzed: 08/28/2017						
Mercury	<0.008 mg/kg	0.008	mg/kg							
LCS (BAH0695-BS1)				Prepared: 08/23/2017 Analyzed: 08/28/2017						
Mercury	0.108 mg/kg	0.008	mg/kg	0.0996	mg/kg	108	80-120			
LCS Dup (BAH0695-BSD1)				Prepared: 08/23/2017 Analyzed: 08/28/2017						
Mercury	0.106 mg/kg	0.008	mg/kg	0.0969	mg/kg	110	80-120	1.24	20	
Matrix Spike (BAH0695-MS1)	**Source: 17H0676-02**			Prepared: 08/23/2017 Analyzed: 08/28/2017						
Mercury	0.251 mg/kg	0.008	mg/kg	0.0998	0.117 mg/kg	134	80-120			M
Matrix Spike (BAH0695-MS2)	**Source: 17H0710-01**			Prepared: 08/23/2017 Analyzed: 08/28/2017						
Mercury	0.159 mg/kg	0.008	mg/kg	0.0980	0.044 mg/kg	118	80-120			
Matrix Spike Dup (BAH0695-MSD1)	**Source: 17H0676-02**			Prepared: 08/23/2017 Analyzed: 08/28/2017						
Mercury	0.151 mg/kg	0.008	mg/kg	0.0998	0.117 mg/kg	34.6	80-120	49.6	20	M, P

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Metals (Total) by EPA 6000/7000 Series Methods - Quality Control

Air Water and Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BAH0695 - SW7471B										
Matrix Spike Dup (BAH0695-MSD2)	**Source: 17H0710-01**			Prepared: 08/23/2017 Analyzed: 08/28/2017						
Mercury	0.157 mg/kg	0.008	mg/kg	0.0924	0.044 mg/kg	123	80-120	1.02	20	M

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Volatile Organic Compounds by GCMS - Quality Control

Air Water and Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BAH0737 - SW5030B										
Blank (BAH0737-BLK1)				Prepared & Analyzed: 08/23/2017						
1,1,1-Trichloroethane	<5.00 ug/kg	5.00	ug/kg							
1,1,2,2-Tetrachloroethane	<5.00 ug/kg	5.00	ug/kg							
1,1,2-Trichloro-1,2,2-trifluoroethane	<5.00 ug/kg	5.00	ug/kg							
1,1,2-Trichloroethane	<5.00 ug/kg	5.00	ug/kg							
1,1-Dichloroethane	<5.00 ug/kg	5.00	ug/kg							
1,1-Dichloroethylene	<5.00 ug/kg	5.00	ug/kg							
1,2,3-Trichlorobenzene	<5.00 ug/kg	5.00	ug/kg							
1,2,4-Trichlorobenzene	<5.00 ug/kg	5.00	ug/kg							
1,2-Dibromo-3-chloropropane (DBCP)	<5.00 ug/kg	5.00	ug/kg							
1,2-Dibromoethane (EDB)	<5.00 ug/kg	5.00	ug/kg							
1,2-Dichlorobenzene	<5.00 ug/kg	5.00	ug/kg							
1,2-Dichloroethane	<5.00 ug/kg	5.00	ug/kg							
1,2-Dichloropropane	<5.00 ug/kg	5.00	ug/kg							
1,3-Dichlorobenzene	<5.00 ug/kg	5.00	ug/kg							
1,4-Dichlorobenzene	<5.00 ug/kg	5.00	ug/kg							
1,4-Dioxane	<100 ug/kg	100	ug/kg							
2-Butanone (MEK)	<5.00 ug/kg	5.00	ug/kg							
2-Hexanone (MBK)	<5.00 ug/kg	5.00	ug/kg							
4-Methyl-2-pentanone (MIBK)	<5.00 ug/kg	5.00	ug/kg							
Acetone	<10.0 ug/kg	10.0	ug/kg							
Benzene	<5.00 ug/kg	5.00	ug/kg							
Bromochloromethane	<5.00 ug/kg	5.00	ug/kg							
Bromodichloromethane	<5.00 ug/kg	5.00	ug/kg							
Bromoform	<5.00 ug/kg	5.00	ug/kg							
Bromomethane	<5.00 ug/kg	5.00	ug/kg							
Carbon disulfide	<5.00 ug/kg	5.00	ug/kg							
Chlorobenzene	<5.00 ug/kg	5.00	ug/kg							
Chloroethane	<5.00 ug/kg	5.00	ug/kg							
Chloroform	<5.00 ug/kg	5.00	ug/kg							
Chloromethane	<5.00 ug/kg	5.00	ug/kg							
cis-1,2-Dichloroethylene	<5.00 ug/kg	5.00	ug/kg							

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Volatile Organic Compounds by GCMS - Quality Control

Air Water and Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BAH0737 - SW5030B										
Blank (BAH0737-BLK1)				Prepared & Analyzed: 08/23/2017						
cis-1,3-Dichloropropene	<5.00 ug/kg	5.00	ug/kg							
Cyclohexane	<5.00 ug/kg	5.00	ug/kg							
Dibromochloromethane	<5.00 ug/kg	5.00	ug/kg							
Dichlorodifluoromethane	<5.00 ug/kg	5.00	ug/kg							
Ethylbenzene	<5.00 ug/kg	5.00	ug/kg							
Isopropylbenzene	<5.00 ug/kg	5.00	ug/kg							
m+p-Xylenes	<5.00 ug/kg	5.00	ug/kg							
Methyl acetate	<5.00 ug/kg	5.00	ug/kg							
Methyl cyclohexane	<5.00 ug/kg	5.00	ug/kg							
Methylene chloride	<5.00 ug/kg	5.00	ug/kg							
Methyl-t-butyl ether (MTBE)	<5.00 ug/kg	5.00	ug/kg							
o-Xylene	<5.00 ug/kg	5.00	ug/kg							
Styrene	<10.0 ug/kg	10.0	ug/kg							
Tetrachloroethylene (PCE)	<5.00 ug/kg	5.00	ug/kg							
Toluene	<5.00 ug/kg	5.00	ug/kg							
trans-1,2-Dichloroethylene	<5.00 ug/kg	5.00	ug/kg							
trans-1,3-Dichloropropene	<5.00 ug/kg	5.00	ug/kg							
Trichloroethylene	<5.00 ug/kg	5.00	ug/kg							
Trichlorofluoromethane	<5.00 ug/kg	5.00	ug/kg							
Vinyl chloride	<5.00 ug/kg	5.00	ug/kg							
Xylenes, Total	<5.00 ug/kg	5.00	ug/kg							
Surr: 1,2-Dichloroethane-d4 (Surr)	50.2		ug/kg	50.0		100	80-120			
Surr: 4-Bromofluorobenzene (Surr)	50.1		ug/kg	50.0		100	85-120			
Surr: Dibromofluoromethane (Surr)	51.0		ug/kg	50.0		102	78-119			
Surr: Toluene-d8 (Surr)	52.3		ug/kg	50.0		105	85-115			
LCS (BAH0737-BS1)				Prepared & Analyzed: 08/23/2017						
1,1,1-Trichloroethane	52.4 ug/L	5	ug/L	50.0	ug/L	105	70-135			
1,1,2,2-Tetrachloroethane	45.7 ug/L	5	ug/L	50.0	ug/L	91.5	55-130			
1,1,2-Trichloroethane	52.8 ug/L	5	ug/L	50.0	ug/L	106	60-125			
1,1-Dichloroethane	56.5 ug/L	5	ug/L	50.0	ug/L	113	75-125			

AIR WATER & SOIL LABORATORIES, INC.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Volatile Organic Compounds by GCMS - Quality Control

Air Water and Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BAH0737 - SW5030B										
LCS (BAH0737-BS1)				Prepared & Analyzed: 08/23/2017						
1,1-Dichloroethylene	52.8 ug/L	5	ug/L	50.0	ug/L	106	65-135			
1,2,3-Trichlorobenzene	47.6 ug/L	5	ug/L	50.0	ug/L	95.2	60-135			
1,2,4-Trichlorobenzene	49.4 ug/L	5	ug/L	50.0	ug/L	98.8	65-130			
1,2-Dibromo-3-chloropropane (DBCP)	45.9 ug/L	5	ug/L	50.0	ug/L	91.8	40-135			
1,2-Dibromoethane (EDB)	47.0 ug/L	5	ug/L	50.0	ug/L	94.1	70-125			
1,2-Dichlorobenzene	47.7 ug/L	5	ug/L	50.0	ug/L	95.4	75-120			
1,2-Dichloroethane	51.4 ug/L	5	ug/L	50.0	ug/L	103	70-135			
1,2-Dichloropropane	53.2 ug/L	5	ug/L	50.0	ug/L	106	70-120			
1,3-Dichlorobenzene	50.2 ug/L	5	ug/L	50.0	ug/L	100	70-125			
1,4-Dichlorobenzene	48.6 ug/L	5	ug/L	50.0	ug/L	97.2	70-125			
2-Butanone (MEK)	47.9 ug/L	5	ug/L	50.0	ug/L	95.9	30-160			
2-Hexanone (MBK)	49.2 ug/L	5	ug/L	50.0	ug/L	98.4	45-145			
4-Methyl-2-pentanone (MIBK)	52.3 ug/L	5	ug/L	50.0	ug/L	105	45-145			
Acetone	47.4 ug/L	10	ug/L	50.0	ug/L	94.8	20-160			
Benzene	53.9 ug/L	5	ug/L	50.0	ug/L	108	75-125			
Bromochloromethane	51.8 ug/L	5	ug/L	50.0	ug/L	104	70-125			
Bromodichloromethane	52.3 ug/L	5	ug/L	50.0	ug/L	105	70-130			
Bromoform	45.7 ug/L	5	ug/L	50.0	ug/L	91.4	55-135			
Bromomethane	51.5 ug/L	5	ug/L	50.0	ug/L	103	30-160			
Carbon disulfide	53.1 ug/L	5	ug/L	50.0	ug/L	106	45-160			
Chlorobenzene	46.8 ug/L	5	ug/L	50.0	ug/L	93.5	75-125			
Chloroethane	57.0 ug/L	5	ug/L	50.0	ug/L	114	40-155			
Chloroform	52.6 ug/L	5	ug/L	50.0	ug/L	105	70-125			
Chloromethane	59.7 ug/L	5	ug/L	50.0	ug/L	119	50-130			
cis-1,2-Dichloroethylene	51.3 ug/L	5	ug/L	50.0	ug/L	103	65-125			
cis-1,3-Dichloropropene	51.7 ug/L	5	ug/L	50.0	ug/L	103	70-125			
Dibromochloromethane	49.6 ug/L	5	ug/L	50.0	ug/L	99.2	65-130			
Dichlorodifluoromethane	67.1 ug/L	5	ug/L	50.0	ug/L	134	35-135			
Ethylbenzene	46.8 ug/L	5	ug/L	50.0	ug/L	93.6	75-125			
Isopropylbenzene	49.4 ug/L	5	ug/L	50.0	ug/L	98.7	75-130			
m+p-Xylenes	94.5 ug/L	5	ug/L	100	ug/L	94.5	80-125			

AIR WATER & SOIL LABORATORIES, INC.

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Certificate of Analysis

Final Report

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Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Volatile Organic Compounds by GCMS - Quality Control

Air Water and Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BAH0737 - SW5030B										
LCS (BAH0737-BS1)				Prepared & Analyzed: 08/23/2017						
Methylene chloride	52.8 ug/L	5	ug/L	50.0	ug/L	106	55-140			
Methyl-t-butyl ether (MTBE)	54.5 ug/L	5	ug/L	50.0	ug/L	109	65-125			
o-Xylene	46.2 ug/L	5	ug/L	50.0	ug/L	92.4	75-125			
Styrene	47.3 ug/L	10	ug/L	50.0	ug/L	94.6	75-125			
Tetrachloroethylene (PCE)	62.4 ug/L	5	ug/L	50.0	ug/L	125	65-140			
Toluene	50.5 ug/L	5	ug/L	50.0	ug/L	101	70-125			
trans-1,2-Dichloroethylene	52.3 ug/L	5	ug/L	50.0	ug/L	105	65-135			
trans-1,3-Dichloropropene	49.8 ug/L	5	ug/L	50.0	ug/L	99.5	65-125			
Trichloroethylene	51.3 ug/L	5	ug/L	50.0	ug/L	103	75-125			
Trichlorofluoromethane	51.8 ug/L	5	ug/L	50.0	ug/L	104	25-185			
Vinyl chloride	56.4 ug/L	5	ug/L	50.0	ug/L	113	60-130			
Surr: 1,2-Dichloroethane-d4 (Surr)	51.3		ug/kg	50.0	ug/kg	103	80-120			
Surr: 4-Bromofluorobenzene (Surr)	49.8		ug/kg	50.0	ug/kg	99.5	85-120			
Surr: Dibromofluoromethane (Surr)	51.5		ug/kg	50.0	ug/kg	103	78-119			
Surr: Toluene-d8 (Surr)	52.1		ug/kg	50.0	ug/kg	104	85-115			
Matrix Spike (BAH0737-MS1)	**Source: 17H0710-01**			Prepared & Analyzed: 08/23/2017						
1,1,1-Trichloroethane	35.9 ug/L	5	ug/L	50.0	<5 ug/L	71.8	70-135			
1,1,2,2-Tetrachloroethane	16.9 ug/L	5	ug/L	50.0	<5 ug/L	33.8	55-130			M
1,1,2-Trichloroethane	22.4 ug/L	5	ug/L	50.0	<5 ug/L	44.7	60-125			M
1,1-Dichloroethane	35.0 ug/L	5	ug/L	50.0	<5 ug/L	70.0	75-125			M
1,1-Dichloroethylene	31.8 ug/L	5	ug/L	50.0	<5 ug/L	63.6	65-135			M
1,2,3-Trichlorobenzene	<5 ug/L	5	ug/L	50.0	<5 ug/L	7.62	60-135			M
1,2,4-Trichlorobenzene	<5 ug/L	5	ug/L	50.0	<5 ug/L	7.27	65-130			M
1,2-Dibromo-3-chloropropane (DBCP)	11.9 ug/L	5	ug/L	50.0	<5 ug/L	23.7	40-135			M
1,2-Dibromoethane (EDB)	11.3 ug/L	5	ug/L	50.0	<5 ug/L	22.6	70-125			M
1,2-Dichlorobenzene	8.15 ug/L	5	ug/L	50.0	<5 ug/L	16.3	75-120			M
1,2-Dichloroethane	20.9 ug/L	5	ug/L	50.0	<5 ug/L	41.8	70-135			M
1,2-Dichloropropane	27.7 ug/L	5	ug/L	50.0	<5 ug/L	55.5	70-120			M
1,3-Dichlorobenzene	7.81 ug/L	5	ug/L	50.0	<5 ug/L	15.6	70-125			M
1,4-Dichlorobenzene	6.63 ug/L	5	ug/L	50.0	<5 ug/L	13.3	70-125			M

AIR WATER & SOIL LABORATORIES, INC.

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Final Report

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Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Volatile Organic Compounds by GCMS - Quality Control

Air Water and Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BAH0737 - SW5030B										
Matrix Spike (BAH0737-MS1)	**Source: 17H0710-01**			Prepared & Analyzed: 08/23/2017						
2-Butanone (MEK)	<5 ug/L	5	ug/L	50.0	<5 ug/L	5.86	30-160			M
2-Hexanone (MBK)	<5 ug/L	5	ug/L	50.0	<5 ug/L		45-145			M
4-Methyl-2-pentanone (MIBK)	7.20 ug/L	5	ug/L	50.0	<5 ug/L	14.4	45-145			M
Acetone	17.4 ug/L	10	ug/L	50.0	<10 ug/L	34.8	20-160			
Benzene	28.3 ug/L	5	ug/L	50.0	<5 ug/L	56.6	75-125			M
Bromochloromethane	20.5 ug/L	5	ug/L	50.0	<5 ug/L	41.0	70-125			M
Bromodichloromethane	22.5 ug/L	5	ug/L	50.0	<5 ug/L	45.1	70-130			M
Bromoform	12.0 ug/L	5	ug/L	50.0	<5 ug/L	24.0	55-135			M
Bromomethane	12.8 ug/L	5	ug/L	50.0	<5 ug/L	25.6	30-160			M
Carbon disulfide	20.7 ug/L	5	ug/L	50.0	<5 ug/L	41.4	45-160			M
Chlorobenzene	13.7 ug/L	5	ug/L	50.0	<5 ug/L	27.3	75-125			M
Chloroethane	36.4 ug/L	5	ug/L	50.0	<5 ug/L	72.8	40-155			
Chloroform	28.7 ug/L	5	ug/L	50.0	<5 ug/L	57.4	70-125			M
Chloromethane	37.2 ug/L	5	ug/L	50.0	<5 ug/L	74.5	50-130			
cis-1,2-Dichloroethylene	21.3 ug/L	5	ug/L	50.0	<5 ug/L	42.6	65-125			M
cis-1,3-Dichloropropene	9.21 ug/L	5	ug/L	50.0	<5 ug/L	18.4	70-125			M
Dibromochloromethane	16.4 ug/L	5	ug/L	50.0	<5 ug/L	32.7	65-130			M
Dichlorodifluoromethane	52.0 ug/L	5	ug/L	50.0	<5 ug/L	104	35-135			
Ethylbenzene	17.1 ug/L	5	ug/L	50.0	<5 ug/L	34.1	75-125			M
Isopropylbenzene	19.8 ug/L	5	ug/L	50.0	<5 ug/L	39.7	75-130			M
m+p-Xylenes	33.8 ug/L	5	ug/L	100	<5 ug/L	33.8	80-125			M
Methylene chloride	26.7 ug/L	5	ug/L	50.0	<5 ug/L	53.5	55-140			M
Methyl-t-butyl ether (MTBE)	39.0 ug/L	5	ug/L	50.0	<5 ug/L	78.0	65-125			
o-Xylene	18.4 ug/L	5	ug/L	50.0	<5 ug/L	36.8	75-125			M
Styrene	<10 ug/L	10	ug/L	50.0	<10 ug/L	17.3	75-125			M
Tetrachloroethylene (PCE)	28.8 ug/L	5	ug/L	50.0	<5 ug/L	57.1	65-140			M
Toluene	22.2 ug/L	5	ug/L	50.0	<5 ug/L	44.3	70-125			M
trans-1,2-Dichloroethylene	22.3 ug/L	5	ug/L	50.0	<5 ug/L	44.7	65-135			M
trans-1,3-Dichloropropene	7.45 ug/L	5	ug/L	50.0	<5 ug/L	14.9	65-125			M
Trichloroethylene	21.4 ug/L	5	ug/L	50.0	<5 ug/L	42.9	75-125			M
Trichlorofluoromethane	37.8 ug/L	5	ug/L	50.0	<5 ug/L	75.6	25-185			

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Client Site I.D.:	Four Mile Run	Purchase Order:	

Volatile Organic Compounds by GCMS - Quality Control

Air Water and Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BAH0737 - SW5030B										
Matrix Spike (BAH0737-MS1)	**Source: 17H0710-01**			Prepared & Analyzed: 08/23/2017						
Vinyl chloride	39.2 ug/L	5	ug/L	50.0	<5 ug/L	78.4	60-130			
Surr: 1,2-Dichloroethane-d4 (Surr)	50.1		ug/kg	50.0	ug/kg	100	80-120			
Surr: 4-Bromofluorobenzene (Surr)	50.2		ug/kg	50.0	ug/kg	100	85-120			
Surr: Dibromofluoromethane (Surr)	50.2		ug/kg	50.0	ug/kg	100	78-119			
Surr: Toluene-d8 (Surr)	51.8		ug/kg	50.0	ug/kg	104	85-115			
Matrix Spike Dup (BAH0737-MSD1)	**Source: 17H0710-01**			Prepared & Analyzed: 08/23/2017						
1,1,1-Trichloroethane	43.8 ug/L	5	ug/L	50.0	<5 ug/L	87.5	70-135	19.7	30	
1,1,2,2-Tetrachloroethane	18.5 ug/L	5	ug/L	50.0	<5 ug/L	36.9	55-130	8.93	30	M
1,1,2-Trichloroethane	25.2 ug/L	5	ug/L	50.0	<5 ug/L	50.4	60-125	11.9	30	M
1,1-Dichloroethane	41.0 ug/L	5	ug/L	50.0	<5 ug/L	82.0	75-125	15.8	30	
1,1-Dichloroethylene	39.0 ug/L	5	ug/L	50.0	<5 ug/L	77.9	65-135	20.3	30	
1,2,3-Trichlorobenzene	<5 ug/L	5	ug/L	50.0	<5 ug/L	8.95	60-135		30	M
1,2,4-Trichlorobenzene	<5 ug/L	5	ug/L	50.0	<5 ug/L	8.51	65-130		30	M
1,2-Dibromo-3-chloropropane (DBCP)	13.3 ug/L	5	ug/L	50.0	<5 ug/L	26.6	40-135	11.4	30	M
1,2-Dibromoethane (EDB)	13.0 ug/L	5	ug/L	50.0	<5 ug/L	25.9	70-125	13.9	30	M
1,2-Dichlorobenzene	9.40 ug/L	5	ug/L	50.0	<5 ug/L	18.8	75-120	14.3	30	M
1,2-Dichloroethane	24.6 ug/L	5	ug/L	50.0	<5 ug/L	49.2	70-135	16.2	30	M
1,2-Dichloropropane	31.6 ug/L	5	ug/L	50.0	<5 ug/L	63.2	70-120	13.0	30	M
1,3-Dichlorobenzene	9.24 ug/L	5	ug/L	50.0	<5 ug/L	18.5	70-125	16.8	30	M
1,4-Dichlorobenzene	7.97 ug/L	5	ug/L	50.0	<5 ug/L	15.9	70-125	18.3	30	M
2-Butanone (MEK)	<5 ug/L	5	ug/L	50.0	<5 ug/L	6.16	30-160		30	M
2-Hexanone (MBK)	<5 ug/L	5	ug/L	50.0	<5 ug/L		45-145		30	M
4-Methyl-2-pentanone (MIBK)	5.88 ug/L	5	ug/L	50.0	<5 ug/L	11.8	45-145	20.2	30	M
Acetone	<10 ug/L	10	ug/L	50.0	<10 ug/L	13.1	20-160	90.4	30	M
Benzene	33.1 ug/L	5	ug/L	50.0	<5 ug/L	66.1	75-125	15.5	30	M
Bromochloromethane	24.4 ug/L	5	ug/L	50.0	<5 ug/L	48.8	70-125	17.4	30	M
Bromodichloromethane	25.8 ug/L	5	ug/L	50.0	<5 ug/L	51.7	70-130	13.7	30	M
Bromoform	13.9 ug/L	5	ug/L	50.0	<5 ug/L	27.8	55-135	14.6	30	M
Bromomethane	13.8 ug/L	5	ug/L	50.0	<5 ug/L	27.7	30-160	8.03	30	M
Carbon disulfide	28.3 ug/L	5	ug/L	50.0	<5 ug/L	56.6	45-160	31.2	30	P

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Final Report

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Volatile Organic Compounds by GCMS - Quality Control

Air Water and Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BAH0737 - SW5030B										
Matrix Spike Dup (BAH0737-MSD1)	**Source: 17H0710-01**			Prepared & Analyzed: 08/23/2017						
Chlorobenzene	16.3 ug/L	5	ug/L	50.0	<5 ug/L	32.6	75-125	17.6	30	M
Chloroethane	44.9 ug/L	5	ug/L	50.0	<5 ug/L	89.7	40-155	20.9	30	
Chloroform	33.2 ug/L	5	ug/L	50.0	<5 ug/L	66.4	70-125	14.4	30	M
Chloromethane	42.5 ug/L	5	ug/L	50.0	<5 ug/L	85.0	50-130	13.1	30	
cis-1,2-Dichloroethylene	25.8 ug/L	5	ug/L	50.0	<5 ug/L	51.5	65-125	19.0	30	M
cis-1,3-Dichloropropene	10.2 ug/L	5	ug/L	50.0	<5 ug/L	20.4	70-125	10.0	30	M
Dibromochloromethane	19.2 ug/L	5	ug/L	50.0	<5 ug/L	38.4	65-130	16.0	30	M
Dichlorodifluoromethane	61.7 ug/L	5	ug/L	50.0	<5 ug/L	123	35-135	17.1	30	
Ethylbenzene	21.4 ug/L	5	ug/L	50.0	<5 ug/L	42.7	75-125	22.4	30	M
Isopropylbenzene	24.7 ug/L	5	ug/L	50.0	<5 ug/L	49.4	75-130	21.8	30	M
m+p-Xylenes	40.7 ug/L	5	ug/L	100	<5 ug/L	40.7	80-125	18.7	30	M
Methylene chloride	30.8 ug/L	5	ug/L	50.0	<5 ug/L	61.6	55-140	14.1	30	
Methyl-t-butyl ether (MTBE)	44.0 ug/L	5	ug/L	50.0	<5 ug/L	88.0	65-125	12.1	30	
o-Xylene	20.9 ug/L	5	ug/L	50.0	<5 ug/L	41.8	75-125	12.6	30	M
Styrene	<10 ug/L	10	ug/L	50.0	<10 ug/L	18.6	75-125		30	M
Tetrachloroethylene (PCE)	36.6 ug/L	5	ug/L	50.0	<5 ug/L	72.7	65-140	23.9	30	
Toluene	26.2 ug/L	5	ug/L	50.0	<5 ug/L	52.3	70-125	16.5	30	M
trans-1,2-Dichloroethylene	29.0 ug/L	5	ug/L	50.0	<5 ug/L	58.1	65-135	26.1	30	M
trans-1,3-Dichloropropene	8.31 ug/L	5	ug/L	50.0	<5 ug/L	16.6	65-125	11.0	30	M
Trichloroethylene	26.8 ug/L	5	ug/L	50.0	<5 ug/L	53.6	75-125	22.3	30	M
Trichlorofluoromethane	46.1 ug/L	5	ug/L	50.0	<5 ug/L	92.2	25-185	19.8	30	
Vinyl chloride	47.0 ug/L	5	ug/L	50.0	<5 ug/L	94.0	60-130	18.1	30	
Surr: 1,2-Dichloroethane-d4 (Surr)	52.9		ug/kg	49.9	ug/kg	106	80-120			
Surr: 4-Bromofluorobenzene (Surr)	50.3		ug/kg	49.9	ug/kg	101	85-120			
Surr: Dibromofluoromethane (Surr)	50.8		ug/kg	49.9	ug/kg	102	78-119			
Surr: Toluene-d8 (Surr)	50.5		ug/kg	49.9	ug/kg	101	85-115			

AIR WATER & SOIL LABORATORIES, INC.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Semivolatile Organic Compounds by GCMS - Quality Control

Air Water and Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BAH0783 - SW3550C										
Blank (BAH0783-BLK1)				Prepared: 08/25/2017 Analyzed: 08/28/2017						
1,1-Biphenyl	<83.3 ug/kg	83.3	ug/kg							
1,2,4,5-Tetrachlorobenzene	<83.3 ug/kg	83.3	ug/kg							
2,3,4,6-Tetrachlorophenol	<83.3 ug/kg	83.3	ug/kg							
2,4,5-Trichlorophenol	<83.3 ug/kg	83.3	ug/kg							
2,4,6-Trichlorophenol	<83.3 ug/kg	83.3	ug/kg							
2,4-Dichlorophenol	<83.3 ug/kg	83.3	ug/kg							
2,4-Dimethylphenol	<83.3 ug/kg	83.3	ug/kg							
2,4-Dinitrophenol	<83.3 ug/kg	83.3	ug/kg							
2,4-Dinitrotoluene	<83.3 ug/kg	83.3	ug/kg							
2,6-Dinitrotoluene	<83.3 ug/kg	83.3	ug/kg							
2-Chloronaphthalene	<83.3 ug/kg	83.3	ug/kg							
2-Chlorophenol	<83.3 ug/kg	83.3	ug/kg							
2-Methylnaphthalene	<83.3 ug/kg	83.3	ug/kg							
2-Nitroaniline	<83.3 ug/kg	83.3	ug/kg							
2-Nitrophenol	<83.3 ug/kg	83.3	ug/kg							
3,3'-Dichlorobenzidine	<83.3 ug/kg	83.3	ug/kg							
3-Nitroaniline	<83.3 ug/kg	83.3	ug/kg							
4,6-Dinitro-2-methylphenol	<83.3 ug/kg	83.3	ug/kg							
4-Bromophenyl phenyl ether	<83.3 ug/kg	83.3	ug/kg							
4-Chlorophenyl phenyl ether	<83.3 ug/kg	83.3	ug/kg							
4-Nitroaniline	<83.3 ug/kg	83.3	ug/kg							
4-Nitrophenol	<83.3 ug/kg	83.3	ug/kg							
Acenaphthene	<83.3 ug/kg	83.3	ug/kg							
Acenaphthylene	<83.3 ug/kg	83.3	ug/kg							
Acetophenone	<83.3 ug/kg	83.3	ug/kg							
Anthracene	<83.3 ug/kg	83.3	ug/kg							
Atrazine	<83.3 ug/kg	83.3	ug/kg							
Benzaldehyde	<83.3 ug/kg	83.3	ug/kg							
Benzo (a) anthracene	<83.3 ug/kg	83.3	ug/kg							
Benzo (a) pyrene	<83.3 ug/kg	83.3	ug/kg							
Benzo (b) fluoranthene	<83.3 ug/kg	83.3	ug/kg							

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Semivolatile Organic Compounds by GCMS - Quality Control

Air Water and Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BAH0783 - SW3550C										
Blank (BAH0783-BLK1)				Prepared: 08/25/2017 Analyzed: 08/28/2017						
Benzo (g,h,i) perylene	<83.3 ug/kg	83.3	ug/kg							
Benzo (k) fluoranthene	<83.3 ug/kg	83.3	ug/kg							
bis (2-Chloroethoxy) methane	<83.3 ug/kg	83.3	ug/kg							
bis (2-Chloroethyl) ether	<83.3 ug/kg	83.3	ug/kg							
2,2'-Oxybis (1-chloropropane)	<83.3 ug/kg	83.3	ug/kg							
bis (2-Ethylhexyl) phthalate	<83.3 ug/kg	83.3	ug/kg							
Butyl benzyl phthalate	<83.3 ug/kg	83.3	ug/kg							
Caprolactam	<83.3 ug/kg	83.3	ug/kg							
Carbazole	<83.3 ug/kg	83.3	ug/kg							
Chrysene	<83.3 ug/kg	83.3	ug/kg							
Dibenz (a,h) anthracene	<83.3 ug/kg	83.3	ug/kg							
Dibenzofuran	<83.3 ug/kg	83.3	ug/kg							
Diethyl phthalate	<83.3 ug/kg	83.3	ug/kg							
Dimethyl phthalate	<83.3 ug/kg	83.3	ug/kg							
Di-n-butyl phthalate	<83.3 ug/kg	83.3	ug/kg							
Di-n-octyl phthalate	<83.3 ug/kg	83.3	ug/kg							
Fluoranthene	<83.3 ug/kg	83.3	ug/kg							
Fluorene	<83.3 ug/kg	83.3	ug/kg							
Hexachlorobenzene	<83.3 ug/kg	83.3	ug/kg							
Hexachlorobutadiene	<83.3 ug/kg	83.3	ug/kg							
Hexachlorocyclopentadiene	<83.3 ug/kg	83.3	ug/kg							
Hexachloroethane	<83.3 ug/kg	83.3	ug/kg							
Indeno (1,2,3-cd) pyrene	<83.3 ug/kg	83.3	ug/kg							
Isophorone	<83.3 ug/kg	83.3	ug/kg							
m+p-Cresols	<83.3 ug/kg	83.3	ug/kg							
Naphthalene	<23.0 ug/kg	23.0	ug/kg							
Nitrobenzene	<83.3 ug/kg	83.3	ug/kg							
n-Nitrosodi-n-propylamine	<83.3 ug/kg	83.3	ug/kg							
n-Nitrosodiphenylamine	<83.3 ug/kg	83.3	ug/kg							
o-Cresol	<83.3 ug/kg	83.3	ug/kg							
p-Chloro-m-cresol	<83.3 ug/kg	83.3	ug/kg							

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Semivolatile Organic Compounds by GCMS - Quality Control

Air Water and Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BAH0783 - SW3550C										
Blank (BAH0783-BLK1)				Prepared: 08/25/2017 Analyzed: 08/28/2017						
Pentachlorophenol	<83.3 ug/kg	83.3	ug/kg							
Phenanthrene	<83.3 ug/kg	83.3	ug/kg							
Phenol	<83.3 ug/kg	83.3	ug/kg							
Surr: 2,4,6-Tribromophenol (Surr)	1820		ug/kg	3210		56.7	35-125			
Surr: 2-Fluorobiphenyl (Surr)	1230		ug/kg	1600		76.5	45-105			
Surr: 2-Fluorophenol (Surr)	2070		ug/kg	3210		64.4	35-105			
Surr: Nitrobenzene-d5 (Surr)	1090		ug/kg	1600		68.2	35-100			
Surr: Phenol-d5 (Surr)	2170		ug/kg	3210		67.6	40-100			
Surr: p-Terphenyl-d14 (Surr)	1260		ug/kg	1600		78.5	30-125			
LCS (BAH0783-BS1)				Prepared: 08/25/2017 Analyzed: 08/28/2017						
1,2,4-Trichlorobenzene	2110 ug/kg	83.3	ug/kg	3120	ug/kg	67.4	21.8-66.7			L
1,2-Dichlorobenzene	2260 ug/kg	83.3	ug/kg	3120	ug/kg	72.4	22-60			L
1,3-Dichlorobenzene	2190 ug/kg	83.3	ug/kg	3120	ug/kg	70.1	22-60			L
1,4-Dichlorobenzene	2160 ug/kg	83.3	ug/kg	3120	ug/kg	69.1	13-68			L
1-Chloronaphthalene	2680 ug/kg	83.3	ug/kg		ug/kg		0-200			
2,4,6-Trichlorophenol	2160 ug/kg	83.3	ug/kg	3120	ug/kg	69.1	50-115			
2,4-Dichlorophenol	2100 ug/kg	83.3	ug/kg	3120	ug/kg	67.3	50-105			
2,4-Dimethylphenol	2100 ug/kg	83.3	ug/kg	3120	ug/kg	67.3	30-110			
2,4-Dinitrophenol	2210 ug/kg	83.3	ug/kg	3120	ug/kg	70.7	15-140			
2,4-Dinitrotoluene	3170 ug/kg	83.3	ug/kg	3120	ug/kg	101	21-99			L
2,6-Dinitrotoluene	2680 ug/kg	83.3	ug/kg	3120	ug/kg	85.9	15-140			
2-Chloronaphthalene	2640 ug/kg	83.3	ug/kg	3120	ug/kg	84.6	45-105			
2-Chlorophenol	2010 ug/kg	83.3	ug/kg	3120	ug/kg	64.5	15-74			
2-Nitrophenol	2030 ug/kg	83.3	ug/kg	3120	ug/kg	65.0	40-115			
3,3'-Dichlorobenzidine	2520 ug/kg	83.3	ug/kg	3120	ug/kg	80.5	20-110			
4,6-Dinitro-2-methylphenol	2510 ug/kg	83.3	ug/kg	3120	ug/kg	80.3	40-130			
4-Bromophenyl phenyl ether	2700 ug/kg	83.3	ug/kg	3120	ug/kg	86.5	15-110			
4-Chlorophenyl phenyl ether	2810 ug/kg	83.3	ug/kg	3120	ug/kg	89.9	15-110			
4-Nitrophenol	2400 ug/kg	83.3	ug/kg	3120	ug/kg	76.9	0-125			
Acenaphthene	2380 ug/kg	83.3	ug/kg	3120	ug/kg	76.2	27.7-85.5			

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Client Site I.D.:	Four Mile Run	Purchase Order:	

Semivolatile Organic Compounds by GCMS - Quality Control

Air Water and Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BAH0783 - SW3550C										
LCS (BAH0783-BS1)				Prepared: 08/25/2017 Analyzed: 08/28/2017						
Acenaphthylene	2640 ug/kg	83.3	ug/kg	3120	ug/kg	84.3	50-105			
Acetophenone	1600 ug/kg	83.3	ug/kg	3120	ug/kg	51.4	0-200			
alpha-Terpineol	2130 ug/kg	83.3	ug/kg	3120	ug/kg	68.3	0-200			
Anthracene	2930 ug/kg	83.3	ug/kg	3120	ug/kg	93.8	55-110			
Benzo (a) anthracene	2650 ug/kg	83.3	ug/kg	3120	ug/kg	84.9	55-110			
Benzo (a) pyrene	2520 ug/kg	83.3	ug/kg	3120	ug/kg	80.7	55-110			
Benzo (b) fluoranthene	2420 ug/kg	83.3	ug/kg	3120	ug/kg	77.5	45-120			
Benzo (g,h,i) perylene	2480 ug/kg	83.3	ug/kg	3120	ug/kg	79.4	40-125			
Benzo (k) fluoranthene	2570 ug/kg	83.3	ug/kg	3120	ug/kg	82.1	45-125			
bis (2-Chloroethoxy) methane	2090 ug/kg	83.3	ug/kg	3120	ug/kg	66.9	40-125			
bis (2-Chloroethyl) ether	2270 ug/kg	83.3	ug/kg	3120	ug/kg	72.7	40-125			
2,2'-Oxybis (1-chloropropane)	2080 ug/kg	83.3	ug/kg	3120	ug/kg	66.4	40-125			
bis (2-Ethylhexyl) phthalate	2980 ug/kg	83.3	ug/kg	3120	ug/kg	95.2	40-125			
Butyl benzyl phthalate	2750 ug/kg	83.3	ug/kg	3120	ug/kg	88.0	45-115			
Carbazole	3230 ug/kg	83.3	ug/kg	3120	ug/kg	103	0-200			
Chrysene	2760 ug/kg	83.3	ug/kg	3120	ug/kg	88.3	55-110			
Dibenz (a,h) anthracene	2860 ug/kg	83.3	ug/kg	3120	ug/kg	91.5	40-125			
Diethyl phthalate	2660 ug/kg	83.3	ug/kg	3120	ug/kg	85.0	40-120			
Dimethyl phthalate	2660 ug/kg	83.3	ug/kg	3120	ug/kg	85.3	25-125			
Di-n-butyl phthalate	3040 ug/kg	83.3	ug/kg	3120	ug/kg	97.4	55-115			
Di-n-octyl phthalate	2680 ug/kg	83.3	ug/kg	3120	ug/kg	85.8	35-135			
Fluoranthene	2590 ug/kg	83.3	ug/kg	3120	ug/kg	83.0	55-115			
Fluorene	2660 ug/kg	83.3	ug/kg	3120	ug/kg	85.1	50-110			
Hexachlorobenzene	2630 ug/kg	83.3	ug/kg	3120	ug/kg	84.2	25-125			
Hexachlorobutadiene	2550 ug/kg	83.3	ug/kg	3120	ug/kg	81.7	25-125			
Hexachlorocyclopentadiene	1550 ug/kg	83.3	ug/kg	3120	ug/kg	49.5	25-125			
Hexachloroethane	2150 ug/kg	83.3	ug/kg	3120	ug/kg	68.8	25-125			
Indeno (1,2,3-cd) pyrene	2690 ug/kg	83.3	ug/kg	3120	ug/kg	86.0	45-125			
Isophorone	2050 ug/kg	83.3	ug/kg	3120	ug/kg	65.5	10-110			
Naphthalene	2090 ug/kg	2.00	ug/kg	3120	ug/kg	66.8	40-100			
Nitrobenzene	2300 ug/kg	83.3	ug/kg	3120	ug/kg	73.5	40-100			

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Semivolatile Organic Compounds by GCMS - Quality Control

Air Water and Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BAH0783 - SW3550C										
LCS (BAH0783-BS1)				Prepared: 08/25/2017 Analyzed: 08/28/2017						
n-Nitrosodimethylamine	1850 ug/kg	83.3	ug/kg	3120	ug/kg	59.3	25-110			
n-Nitrosodi-n-propylamine	2060 ug/kg	83.3	ug/kg	3120	ug/kg	65.8	12-97			
n-Nitrosodiphenylamine	2280 ug/kg	83.3	ug/kg	3120	ug/kg	73.1	12-97			
p-Chloro-m-cresol	2220 ug/kg	83.3	ug/kg	3120	ug/kg	71.1	10-91			
Pentachlorophenol	2080 ug/kg	83.3	ug/kg	3120	ug/kg	66.5	30-109			
Phenanthrene	2660 ug/kg	83.3	ug/kg	3120	ug/kg	85.0	50-115			
Phenol	2150 ug/kg	83.3	ug/kg	3160	ug/kg	68.1	0-115			
Pyrene	2700 ug/kg	83.3	ug/kg	3120	ug/kg	86.4	27-110			
Pyridine	1720 ug/kg	83.3	ug/kg	3120	ug/kg	55.2	0-200			
Surr: 2,4,6-Tribromophenol (Surr)	2800		ug/kg	3120	ug/kg	89.4	35-125			
Surr: 2-Fluorobiphenyl (Surr)	1290		ug/kg	1560	ug/kg	82.8	45-105			
Surr: 2-Fluorophenol (Surr)	2350		ug/kg	3120	ug/kg	75.1	35-105			
Surr: Nitrobenzene-d5 (Surr)	1170		ug/kg	1560	ug/kg	74.8	35-100			
Surr: Phenol-d5 (Surr)	2260		ug/kg	3120	ug/kg	72.3	40-100			
Surr: p-Terphenyl-d14 (Surr)	1660		ug/kg	1560	ug/kg	106	30-125			
Matrix Spike (BAH0783-MS1)	**Source: 17H0710-07**			Prepared: 08/25/2017 Analyzed: 08/28/2017						
1,2,4-Trichlorobenzene	1780 ug/kg	328	ug/kg	3280	<328 ug/kg	54.4	21.8-66.7			
1,2-Dichlorobenzene	2270 ug/kg	328	ug/kg	3280	<328 ug/kg	69.2	22-60			M2
1,3-Dichlorobenzene	1890 ug/kg	328	ug/kg	3280	<328 ug/kg	57.6	22-60			
1,4-Dichlorobenzene	1920 ug/kg	328	ug/kg	3280	<328 ug/kg	58.6	22-60			
1-Chloronaphthalene	2070 ug/kg	328	ug/kg		<328 ug/kg		0-200			
2,4-Dichlorophenol	715 ug/kg	328	ug/kg	3280	<328 ug/kg	21.8	50-105			M2
2,4-Dimethylphenol	1640 ug/kg	328	ug/kg	3280	<328 ug/kg	50.1	30-110			
2,4-Dinitrophenol	<328 ug/kg	328	ug/kg	3280	<328 ug/kg		15-140			M2
2,4-Dinitrotoluene	2010 ug/kg	328	ug/kg	3280	<328 ug/kg	61.4	17-111			
2,6-Dinitrotoluene	1960 ug/kg	328	ug/kg	3280	<328 ug/kg	59.8	15-140			
2-Chloronaphthalene	2030 ug/kg	328	ug/kg	3280	<328 ug/kg	62.0	45-105			
2-Chlorophenol	1450 ug/kg	328	ug/kg	3280	<328 ug/kg	44.2	19-64			
2-Nitrophenol	763 ug/kg	328	ug/kg	3280	<328 ug/kg	23.3	40-115			M2
3,3'-Dichlorobenzidine	2250 ug/kg	328	ug/kg	3280	<328 ug/kg	68.5	20-110			

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Semivolatile Organic Compounds by GCMS - Quality Control

Air Water and Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BAH0783 - SW3550C										
Matrix Spike (BAH0783-MS1)	**Source: 17H0710-07**			Prepared: 08/25/2017 Analyzed: 08/28/2017						
4,6-Dinitro-2-methylphenol	<328 ug/kg	328	ug/kg	3280	<328 ug/kg		40-130			M2
4-Bromophenyl phenyl ether	2130 ug/kg	328	ug/kg	3280	<328 ug/kg	65.0	15-110			
4-Chlorophenyl phenyl ether	2130 ug/kg	328	ug/kg	3280	<328 ug/kg	65.0	15-110			
Acenaphthene	2030 ug/kg	328	ug/kg	3280	<328 ug/kg	61.9	24-90			
Acenaphthylene	2580 ug/kg	328	ug/kg	3280	<328 ug/kg	78.7	50-105			
Acetophenone	1430 ug/kg	328	ug/kg	3280	<328 ug/kg	43.7	0-200			
alpha-Terpineol	2000 ug/kg	328	ug/kg	3280	<328 ug/kg	61.0	0-200			
Anthracene	2070 ug/kg	328	ug/kg	3280	<328 ug/kg	63.1	55-110			
Benzo (a) anthracene	2320 ug/kg	328	ug/kg	3280	<328 ug/kg	70.8	55-110			
Benzo (a) pyrene	2180 ug/kg	328	ug/kg	3280	<328 ug/kg	66.5	55-110			
Benzo (b) fluoranthene	2660 ug/kg	328	ug/kg	3280	<328 ug/kg	81.0	45-120			
Benzo (g,h,i) perylene	2580 ug/kg	328	ug/kg	3280	<328 ug/kg	78.8	40-125			
Benzo (k) fluoranthene	2790 ug/kg	328	ug/kg	3280	<328 ug/kg	85.1	45-125			
bis (2-Chloroethoxy) methane	1660 ug/kg	328	ug/kg	3280	<328 ug/kg	50.5	40-125			
bis (2-Chloroethyl) ether	2250 ug/kg	328	ug/kg	3280	<328 ug/kg	68.5	40-125			
2,2'-Oxybis (1-chloropropane)	2040 ug/kg	328	ug/kg	3280	<328 ug/kg	62.2	40-125			
bis (2-Ethylhexyl) phthalate	2160 ug/kg	328	ug/kg	3280	<328 ug/kg	65.8	40-125			
Butyl benzyl phthalate	2490 ug/kg	328	ug/kg	3280	<328 ug/kg	76.1	45-115			
Carbazole	2450 ug/kg	328	ug/kg	3280	<328 ug/kg	74.6	0-200			
Chrysene	2170 ug/kg	328	ug/kg	3280	<328 ug/kg	66.0	55-110			
Dibenz (a,h) anthracene	2460 ug/kg	328	ug/kg	3280	<328 ug/kg	75.2	40-125			
Diethyl phthalate	2230 ug/kg	328	ug/kg	3280	<328 ug/kg	67.9	40-120			
Dimethyl phthalate	2010 ug/kg	328	ug/kg	3280	<328 ug/kg	61.2	25-125			
Di-n-butyl phthalate	2420 ug/kg	328	ug/kg	3280	<328 ug/kg	73.7	55-115			
Di-n-octyl phthalate	2870 ug/kg	328	ug/kg	3280	<328 ug/kg	87.7	35-135			
Fluoranthene	2180 ug/kg	328	ug/kg	3280	<328 ug/kg	66.4	55-115			
Fluorene	2220 ug/kg	328	ug/kg	3280	<328 ug/kg	67.8	50-110			
Hexachlorobenzene	2290 ug/kg	328	ug/kg	3280	<328 ug/kg	69.9	25-125			
Hexachlorobutadiene	2060 ug/kg	328	ug/kg	3280	<328 ug/kg	62.9	25-125			
Hexachlorocyclopentadiene	732 ug/kg	328	ug/kg	3280	<328 ug/kg	22.3	25-125			M2
Hexachloroethane	2190 ug/kg	328	ug/kg	3280	<328 ug/kg	66.9	25-125			

AIR WATER & SOIL LABORATORIES, INC.

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Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Semivolatile Organic Compounds by GCMS - Quality Control

Air Water and Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BAH0783 - SW3550C										
Matrix Spike (BAH0783-MS1)	**Source: 17H0710-07**			Prepared: 08/25/2017 Analyzed: 08/28/2017						
Indeno (1,2,3-cd) pyrene	2310 ug/kg	328	ug/kg	3280	<328 ug/kg	70.5	45-125			
Isophorone	1640 ug/kg	328	ug/kg	3280	<328 ug/kg	50.1	10-110			
Naphthalene	1840 ug/kg	7.87	ug/kg	3280	29.0 ug/kg	55.2	40-100			
Nitrobenzene	2300 ug/kg	328	ug/kg	3280	<328 ug/kg	70.2	40-100			
n-Nitrosodimethylamine	1770 ug/kg	328	ug/kg	3280	<328 ug/kg	53.9	25-110			
n-Nitrosodi-n-propylamine	1910 ug/kg	328	ug/kg	3280	<328 ug/kg	58.3	12-97			
n-Nitrosodiphenylamine	1820 ug/kg	328	ug/kg	3280	<328 ug/kg	55.6	12-97			
p-Chloro-m-cresol	1660 ug/kg	328	ug/kg	3280	<328 ug/kg	50.8	10-91			
Phenanthrene	2170 ug/kg	328	ug/kg	3280	<328 ug/kg	66.0	50-115			
Phenol	1800 ug/kg	328	ug/kg	3310	<328 ug/kg	54.3	0-115			
Pyrene	2340 ug/kg	328	ug/kg	3280	<328 ug/kg	71.4	23-110			
Pyridine	1590 ug/kg	328	ug/kg	3280	<328 ug/kg	48.5	0-200			
Surr: 2,4,6-Tribromophenol (Surr)	182		ug/kg	3280	ug/kg	5.56	35-125			DS
Surr: 2-Fluorobiphenyl (Surr)	1040		ug/kg	1640	ug/kg	63.6	45-105			
Surr: 2-Fluorophenol (Surr)	1090		ug/kg	3280	ug/kg	33.1	35-105			DS
Surr: Nitrobenzene-d5 (Surr)	1300		ug/kg	1640	ug/kg	79.2	35-100			
Surr: Phenol-d5 (Surr)	2030		ug/kg	3280	ug/kg	62.0	40-100			
Surr: p-Terphenyl-d14 (Surr)	1280		ug/kg	1640	ug/kg	78.0	30-125			
Matrix Spike Dup (BAH0783-MSD1)	**Source: 17H0710-07**			Prepared: 08/25/2017 Analyzed: 08/28/2017						
1,2,4-Trichlorobenzene	2380 ug/kg	323	ug/kg	3240	<323 ug/kg	73.5	21.8-66.7	28.6	20	M2, P
1,2-Dichlorobenzene	2500 ug/kg	323	ug/kg	3240	<323 ug/kg	77.1	22-60	9.58	20	M2
1,3-Dichlorobenzene	2260 ug/kg	323	ug/kg	3240	<323 ug/kg	69.8	22-60	17.9	20	M2
1,4-Dichlorobenzene	2270 ug/kg	323	ug/kg	3240	<323 ug/kg	70.1	22-60	16.6	20	M2
1-Chloronaphthalene	2600 ug/kg	323	ug/kg		<323 ug/kg		0-200	22.8	20	P
2,4-Dichlorophenol	601 ug/kg	323	ug/kg	3240	<323 ug/kg	18.6	50-105	17.3	20	M2
2,4-Dimethylphenol	2210 ug/kg	323	ug/kg	3240	<323 ug/kg	68.3	30-110	29.4	20	P
2,4-Dinitrophenol	<323 ug/kg	323	ug/kg	3240	<323 ug/kg		15-140		20	M2
2,4-Dinitrotoluene	2480 ug/kg	323	ug/kg	3240	<323 ug/kg	76.6	17-111	20.7	20	P
2,6-Dinitrotoluene	2420 ug/kg	323	ug/kg	3240	<323 ug/kg	74.7	15-140	20.9	20	P
2-Chloronaphthalene	2560 ug/kg	323	ug/kg	3240	<323 ug/kg	79.0	45-105	22.9	20	P

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Client Site I.D.:	Four Mile Run	Purchase Order:	

Semivolatile Organic Compounds by GCMS - Quality Control

Air Water and Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BAH0783 - SW3550C										
Matrix Spike Dup (BAH0783-MSD1)	**Source: 17H0710-07**			Prepared: 08/25/2017 Analyzed: 08/28/2017						
2-Chlorophenol	1280 ug/kg	323	ug/kg	3240	<323 ug/kg	39.5	19-64	12.7	20	
2-Nitrophenol	757 ug/kg	323	ug/kg	3240	<323 ug/kg	23.4	40-115	0.789	20	M2
3,3'-Dichlorobenzidine	2440 ug/kg	323	ug/kg	3240	<323 ug/kg	75.4	20-110	8.27	20	
4,6-Dinitro-2-methylphenol	<323 ug/kg	323	ug/kg	3240	<323 ug/kg		40-130		20	M2
4-Bromophenyl phenyl ether	2770 ug/kg	323	ug/kg	3240	<323 ug/kg	85.6	15-110	26.1	20	P
4-Chlorophenyl phenyl ether	2610 ug/kg	323	ug/kg	3240	<323 ug/kg	80.6	15-110	20.1	20	P
Acenaphthene	2560 ug/kg	323	ug/kg	3240	<323 ug/kg	79.0	24-90	23.0	20	P
Acenaphthylene	2780 ug/kg	323	ug/kg	3240	<323 ug/kg	86.0	50-105	7.54	20	
Acetophenone	1660 ug/kg	323	ug/kg	3240	<323 ug/kg	51.2	0-200	14.5	20	
alpha-Terpineol	2470 ug/kg	323	ug/kg	3240	<323 ug/kg	76.3	0-200	21.0	20	P
Anthracene	2560 ug/kg	323	ug/kg	3240	<323 ug/kg	79.2	55-110	21.4	20	P
Benzo (a) anthracene	2500 ug/kg	323	ug/kg	3240	<323 ug/kg	77.2	55-110	7.35	20	
Benzo (a) pyrene	2640 ug/kg	323	ug/kg	3240	<323 ug/kg	81.4	55-110	18.9	20	
Benzo (b) fluoranthene	3110 ug/kg	323	ug/kg	3240	<323 ug/kg	96.0	45-120	15.6	20	
Benzo (g,h,i) perylene	2350 ug/kg	323	ug/kg	3240	<323 ug/kg	72.7	40-125	9.33	20	
Benzo (k) fluoranthene	3000 ug/kg	323	ug/kg	3240	<323 ug/kg	92.7	45-125	7.25	20	
bis (2-Chloroethoxy) methane	2310 ug/kg	323	ug/kg	3240	<323 ug/kg	71.2	40-125	32.8	20	P
bis (2-Chloroethyl) ether	2460 ug/kg	323	ug/kg	3240	<323 ug/kg	76.1	40-125	9.21	20	
2,2'-Oxybis (1-chloropropane)	2150 ug/kg	323	ug/kg	3240	<323 ug/kg	66.6	40-125	5.47	20	
bis (2-Ethylhexyl) phthalate	2250 ug/kg	323	ug/kg	3240	<323 ug/kg	69.6	40-125	4.31	20	
Butyl benzyl phthalate	2410 ug/kg	323	ug/kg	3240	<323 ug/kg	74.4	45-115	3.54	20	
Carbazole	2850 ug/kg	323	ug/kg	3240	<323 ug/kg	88.1	0-200	15.3	20	
Chrysene	3100 ug/kg	323	ug/kg	3240	<323 ug/kg	95.8	55-110	35.6	20	P
Dibenz (a,h) anthracene	2560 ug/kg	323	ug/kg	3240	<323 ug/kg	79.1	40-125	3.78	20	
Diethyl phthalate	2370 ug/kg	323	ug/kg	3240	<323 ug/kg	73.3	40-120	6.40	20	
Dimethyl phthalate	2360 ug/kg	323	ug/kg	3240	<323 ug/kg	72.8	25-125	16.1	20	
Di-n-butyl phthalate	2560 ug/kg	323	ug/kg	3240	<323 ug/kg	79.0	55-115	5.61	20	
Di-n-octyl phthalate	3560 ug/kg	323	ug/kg	3240	<323 ug/kg	110	35-135	21.2	20	P
Fluoranthene	3080 ug/kg	323	ug/kg	3240	<323 ug/kg	95.2	55-115	34.3	20	P
Fluorene	2670 ug/kg	323	ug/kg	3240	<323 ug/kg	82.5	50-110	18.2	20	
Hexachlorobenzene	2850 ug/kg	323	ug/kg	3240	<323 ug/kg	88.1	25-125	21.8	20	P

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Semivolatile Organic Compounds by GCMS - Quality Control

Air Water and Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BAH0783 - SW3550C										
Matrix Spike Dup (BAH0783-MSD1)	**Source: 17H0710-07**		Prepared: 08/25/2017 Analyzed: 08/28/2017							
Hexachlorobutadiene	2780 ug/kg	323	ug/kg	3240	<323 ug/kg	85.8	25-125	29.5	20	P
Hexachlorocyclopentadiene	844 ug/kg	323	ug/kg	3240	<323 ug/kg	26.1	25-125	14.2	20	
Hexachloroethane	2660 ug/kg	323	ug/kg	3240	<323 ug/kg	82.1	25-125	19.2	20	
Indeno (1,2,3-cd) pyrene	2490 ug/kg	323	ug/kg	3240	<323 ug/kg	77.0	45-125	7.43	20	
Isophorone	2260 ug/kg	323	ug/kg	3240	<323 ug/kg	69.8	10-110	31.6	20	P
Naphthalene	2330 ug/kg	7.77	ug/kg	3240	29.0 ug/kg	71.1	40-100	23.5	20	P
Nitrobenzene	2870 ug/kg	323	ug/kg	3240	<323 ug/kg	88.8	40-100	22.0	20	P
n-Nitrosodimethylamine	1690 ug/kg	323	ug/kg	3240	<323 ug/kg	52.3	25-110	4.31	20	
n-Nitrosodi-n-propylamine	2220 ug/kg	323	ug/kg	3240	<323 ug/kg	68.6	12-97	15.0	20	
n-Nitrosodiphenylamine	1760 ug/kg	323	ug/kg	3240	<323 ug/kg	54.4	12-97	3.49	20	
p-Chloro-m-cresol	2050 ug/kg	323	ug/kg	3240	<323 ug/kg	63.4	10-91	20.9	20	P
Phenanthrene	2720 ug/kg	323	ug/kg	3240	<323 ug/kg	84.1	50-115	22.8	20	P
Phenol	2010 ug/kg	323	ug/kg	3270	<323 ug/kg	61.4	0-115	11.1	20	
Pyrene	2420 ug/kg	323	ug/kg	3240	<323 ug/kg	74.6	23-110	3.13	20	
Pyridine	1750 ug/kg	323	ug/kg	3240	<323 ug/kg	54.0	0-200	9.46	20	
Surr: 2,4,6-Tribromophenol (Surr)	163		ug/kg	3240	ug/kg	5.04	35-125			DS
Surr: 2-Fluorobiphenyl (Surr)	1260		ug/kg	1620	ug/kg	77.9	45-105			
Surr: 2-Fluorophenol (Surr)	1000		ug/kg	3240	ug/kg	31.0	35-105			DS
Surr: Nitrobenzene-d5 (Surr)	1480		ug/kg	1620	ug/kg	91.3	35-100			
Surr: Phenol-d5 (Surr)	2090		ug/kg	3240	ug/kg	64.7	40-100			
Surr: p-Terphenyl-d14 (Surr)	1510		ug/kg	1620	ug/kg	93.4	30-125			

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Organochlorine Pesticides and PCBs by GC/ECD - Quality Control

Air Water and Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BAH0795 - SW3550B										
Blank (BAH0795-BLK1)				Prepared: 08/25/2017 Analyzed: 08/28/2017						
PCB as Aroclor 1016	<0.100 mg/kg wet	0.100	mg/kg wet							
PCB as Aroclor 1221	<0.100 mg/kg wet	0.100	mg/kg wet							
PCB as Aroclor 1232	<0.100 mg/kg wet	0.100	mg/kg wet							
PCB as Aroclor 1242	<0.100 mg/kg wet	0.100	mg/kg wet							
PCB as Aroclor 1248	<0.100 mg/kg wet	0.100	mg/kg wet							
PCB as Aroclor 1254	<0.100 mg/kg wet	0.100	mg/kg wet							
PCB as Aroclor 1260	<0.100 mg/kg wet	0.100	mg/kg wet							
Surr: DCB	0.0258		mg/kg wet	0.0323		80.0	30-105			
Surr: TCMX	0.0274		mg/kg wet	0.0323		85.0	30-105			
LCS (BAH0795-BS1)				Prepared: 08/25/2017 Analyzed: 08/28/2017						
PCB as Aroclor 1016	0.141 mg/kg wet	0.100	mg/kg wet	0.150	mg/kg wet	94.0	60-140			
PCB as Aroclor 1260	0.122 mg/kg wet	0.100	mg/kg wet	0.150	mg/kg wet	81.0	60-140			
Surr: DCB	0.0240		mg/kg wet	0.0300	mg/kg wet	80.0	30-105			
Surr: TCMX	0.0210		mg/kg wet	0.0300	mg/kg wet	70.0	30-105			
Matrix Spike (BAH0795-MS1)		**Source: 17H0710-09**		Prepared: 08/25/2017 Analyzed: 08/28/2017						
PCB as Aroclor 1016	0.650 mg/kg dry	0.113	mg/kg dry	0.188	<0.113 mg/kg dry	345	60-140			M
PCB as Aroclor 1260	0.162 mg/kg dry	0.113	mg/kg dry	0.188	<0.113 mg/kg dry	86.0	60-140			
Surr: DCB	0.0283		mg/kg dry	0.0377	mg/kg dry	75.0	30-105			
Surr: TCMX	0.0358		mg/kg dry	0.0377	mg/kg dry	95.0	30-105			
Matrix Spike Dup (BAH0795-MSD1)		**Source: 17H0710-09**		Prepared: 08/25/2017 Analyzed: 08/28/2017						
PCB as Aroclor 1016	0.302 mg/kg dry	0.115	mg/kg dry	0.191	<0.115 mg/kg dry	158	60-140	73.2	20	M
PCB as Aroclor 1260	0.166 mg/kg dry	0.115	mg/kg dry	0.191	<0.115 mg/kg dry	87.0	60-140	2.48	20	
Surr: DCB	0.0286		mg/kg dry	0.0382	mg/kg dry	75.0	30-105			
Surr: TCMX	0.0363		mg/kg dry	0.0382	mg/kg dry	95.0	30-105			

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Wet Chemistry Analysis - Quality Control

Air Water and Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BAH0706 - No Prep Wet Chem										
Blank (BAH0706-BLK1)				Prepared & Analyzed: 08/23/2017						
Percent Solids	100 %	0.10	%							
Duplicate (BAH0706-DUP1)		**Source: 17H0710-09**		Prepared & Analyzed: 08/23/2017						
Percent Solids	87.7 %	0.10	%		87.0 %			0.802	20	
Duplicate (BAH0706-DUP2)		**Source: 17H0751-01**		Prepared & Analyzed: 08/23/2017						
Percent Solids	88.1 %	0.10	%		87.9 %			0.241	20	

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Certified Analyses included in this Report

Analyte	Certifications
SW6010C in Solids	
Aluminum	VELAP
Antimony	VELAP
Arsenic	VELAP
Barium	VELAP,WVDEP
Beryllium	VELAP
Cadmium	VELAP,WVDEP
Calcium	VELAP
Chromium	VELAP
Cobalt	VELAP
Copper	VELAP
Iron	VELAP
Lead	VELAP,WVDEP
Magnesium	VELAP
Manganese	VELAP
Nickel	VELAP
Potassium	VELAP
Selenium	VELAP,WVDEP
Silver	VELAP,WVDEP
Sodium	VELAP
Thallium	VELAP
Vanadium	VELAP
Zinc	VELAP
SW7471B in Solids	
Mercury	VELAP,WVDEP
SW8082A in Solids	
PCB as Aroclor 1016	VELAP,NC
PCB as Aroclor 1221	VELAP,NC
PCB as Aroclor 1232	VELAP,NC
PCB as Aroclor 1242	VELAP,NC
PCB as Aroclor 1248	VELAP,NC
PCB as Aroclor 1254	VELAP,NC
PCB as Aroclor 1260	VELAP,NC
SW8260B in Solids	
1,1,1-Trichloroethane	NC,VELAP,WVDEP
1,1,2,2-Tetrachloroethane	NC,VELAP,WVDEP
1,1,2-Trichloro-1,2,2-trifluoroethane	NC,VELAP,WVDEP

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Certified Analyses included in this Report

Analyte	Certifications
1,1,2-Trichloroethane	NC,VELAP,WVDEP
1,1-Dichloroethane	NC,VELAP,WVDEP
1,1-Dichloroethylene	NC,VELAP,WVDEP
1,2,3-Trichlorobenzene	NC,VELAP,WVDEP
1,2,4-Trichlorobenzene	NC,VELAP,WVDEP
1,2-Dibromo-3-chloropropane (DBCP)	NC,VELAP,WVDEP
1,2-Dibromoethane (EDB)	NC,VELAP,WVDEP
1,2-Dichlorobenzene	NC,VELAP,WVDEP
1,2-Dichloroethane	NC,VELAP,WVDEP
1,2-Dichloropropane	NC,VELAP,WVDEP
1,3-Dichlorobenzene	NC,VELAP,WVDEP
1,4-Dichlorobenzene	NC,VELAP,WVDEP
1,4-Dioxane	NC,WVDEP
2-Butanone (MEK)	NC,VELAP,WVDEP
2-Hexanone (MBK)	NC,VELAP,WVDEP
4-Methyl-2-pentanone (MIBK)	NC,VELAP,WVDEP
Acetone	NC,VELAP,WVDEP
Benzene	NC,VELAP,WVDEP
Bromochloromethane	NC,VELAP,WVDEP
Bromodichloromethane	NC,VELAP,WVDEP
Bromoform	NC,VELAP,WVDEP
Bromomethane	NC,VELAP,WVDEP
Carbon disulfide	NC,VELAP,WVDEP
Chlorobenzene	NC,VELAP,WVDEP
Chloroethane	NC,VELAP,WVDEP
Chloroform	NC,VELAP,WVDEP
Chloromethane	NC,VELAP,WVDEP
cis-1,2-Dichloroethylene	NC,VELAP,WVDEP
cis-1,3-Dichloropropene	NC,VELAP,WVDEP
Cyclohexane	NC,VELAP,WVDEP
Dibromochloromethane	NC,WVDEP
Dichlorodifluoromethane	NC,VELAP,WVDEP
Ethylbenzene	NC,VELAP,WVDEP
Isopropylbenzene	NC,VELAP,WVDEP
m+p-Xylenes	NC,VELAP,WVDEP
Methyl acetate	NC,WVDEP
Methyl cyclohexane	NC,VELAP,WVDEP
Methylene chloride	NC,VELAP,WVDEP

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Certified Analyses included in this Report

Analyte	Certifications
Methyl-t-butyl ether (MTBE)	NC,VELAP,WVDEP
o-Xylene	NC,VELAP,WVDEP
Styrene	NC,VELAP,WVDEP
Tetrachloroethylene (PCE)	NC,VELAP,WVDEP
Toluene	NC,VELAP,WVDEP
trans-1,2-Dichloroethylene	NC,VELAP,WVDEP
trans-1,3-Dichloropropene	NC,VELAP,WVDEP
Trichloroethylene	NC,VELAP,WVDEP
Trichlorofluoromethane	NC,VELAP,WVDEP
Vinyl chloride	NC,VELAP,WVDEP
Xylenes, Total	NC,VELAP,WVDEP
Dibromofluoromethane (Surr)	VELAP
SW8270D in Solids	
1,1-Biphenyl	NC,WVDEP
1,2,4,5-Tetrachlorobenzene	NC,VELAP,WVDEP
2,3,4,6-Tetrachlorophenol	NC,VELAP,WVDEP
2,4,5-Trichlorophenol	NC,VELAP,WVDEP
2,4,6-Trichlorophenol	NC,VELAP,WVDEP
2,4-Dichlorophenol	NC,VELAP,WVDEP
2,4-Dimethylphenol	NC,VELAP,WVDEP
2,4-Dinitrophenol	NC,VELAP,WVDEP
2,4-Dinitrotoluene	NC,VELAP,WVDEP
2,6-Dinitrotoluene	NC,VELAP,WVDEP
2-Chloronaphthalene	NC,VELAP,WVDEP
2-Chlorophenol	NC,VELAP,WVDEP
2-Methylnaphthalene	NC,VELAP,WVDEP
2-Nitroaniline	NC,VELAP,WVDEP
2-Nitrophenol	NC,VELAP,WVDEP
3-Nitroaniline	NC,VELAP,WVDEP
4,6-Dinitro-2-methylphenol	NC,VELAP,WVDEP
4-Bromophenyl phenyl ether	NC,VELAP,WVDEP
4-Chlorophenyl phenyl ether	NC,VELAP,WVDEP
4-Nitroaniline	NC,VELAP,WVDEP
4-Nitrophenol	NC,VELAP,WVDEP
Acenaphthene	NC,VELAP,WVDEP
Acenaphthylene	NC,VELAP,WVDEP
Acetophenone	NC,VELAP,WVDEP

AIR WATER SOIL LABORATORIES, INC.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	HDR Engineering-Glen Allen 4470 Cox Road, Suite 200 Glen Allen VA, 23060	Date Issued:	8/30/2017 10:53
Submitted To:	Joe Wallen	Project Number:	10055101
Client Site I.D.:	Four Mile Run	Purchase Order:	

Certified Analyses included in this Report

Analyte	Certifications
Anthracene	NC,VELAP,WVDEP
Atrazine	NC,WVDEP
Benzaldehyde	NC,WVDEP
Benzo (a) anthracene	NC,VELAP,WVDEP
Benzo (a) pyrene	NC,VELAP,WVDEP
Benzo (b) fluoranthene	NC,VELAP,WVDEP
Benzo (g,h,i) perylene	NC,VELAP,WVDEP
Benzo (k) fluoranthene	NC,VELAP,WVDEP
bis (2-Chloroethoxy) methane	NC,VELAP,WVDEP
bis (2-Chloroethyl) ether	NC,VELAP,WVDEP
2,2'-Oxybis (1-chloropropane)	NC,VELAP,WVDEP
bis (2-Ethylhexyl) phthalate	NC,VELAP,WVDEP
Butyl benzyl phthalate	NC,VELAP,WVDEP
Caprolactam	NC,WVDEP
Carbazole	NC,VELAP,WVDEP
Chrysene	NC,VELAP,WVDEP
Dibenz (a,h) anthracene	NC,VELAP,WVDEP
Dibenzofuran	NC,VELAP,WVDEP
Diethyl phthalate	NC,VELAP,WVDEP
Dimethyl phthalate	NC,VELAP,WVDEP
Di-n-butyl phthalate	NC,VELAP,WVDEP
Di-n-octyl phthalate	NC,VELAP,WVDEP
Fluoranthene	NC,VELAP,WVDEP
Fluorene	NC,VELAP,WVDEP
Hexachlorobenzene	NC,VELAP,WVDEP
Hexachlorobutadiene	NC,VELAP,WVDEP
Hexachlorocyclopentadiene	NC,VELAP,WVDEP
Hexachloroethane	NC,VELAP,WVDEP
Indeno (1,2,3-cd) pyrene	NC,VELAP,WVDEP
Isophorone	NC,VELAP,WVDEP
m+p-Cresols	NC,VELAP,WVDEP
Naphthalene	NC,VELAP,WVDEP
Nitrobenzene	NC,VELAP,WVDEP
n-Nitrosodi-n-propylamine	NC,VELAP,WVDEP
n-Nitrosodiphenylamine	NC,VELAP,WVDEP
o-Cresol	NC,VELAP,WVDEP
p-Chloro-m-cresol	NC,VELAP,WVDEP
Pentachlorophenol	NC,VELAP,WVDEP

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Certified Analyses included in this Report

Analyte	Certifications
Phenanthrene	NC,VELAP,WVDEP
Phenol	NC,VELAP,WVDEP

Code	Description	Lab Number	Expires
MdDOE	Maryland DE Drinking Water	341	12/31/2017
NC	North Carolina DENR	495	12/31/2017
PADEP	NELAC-Pennsylvania	001	10/31/2017
VELAP	NELAC-Virginia Certificate #9316	460021	06/14/2018
WVDEP	West Virginia DEP	350	11/30/2017

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Summary of Data Qualifiers

B	Blank contamination. The recorded result is associated with a contaminated blank.
DS	Surrogate concentration reflects a dilution factor.
E	Estimated concentration, outside calibration range
L	LCS recovery is outside of established acceptance limits
M	Matrix spike recovery is outside established acceptance limits
M2	Sample was diluted due to matrix interference.
P	Duplicate analysis does not meet the acceptance criteria for precision
S	Surrogate recovery was outside acceptance criteria
RPD	Relative Percent Difference
Qual	Qualifers
-RE	Denotes sample was re-analyzed
D.F.	Dilution Factor. Please also see the Preparation Factor in the Analysis Summary section.
TIC	Tentatively Identified Compounds are compounds that are identified by comparing the analyte mass spectral pattern with the NIST spectral library . A TIC spectral match is reported when the pattern is at least 75% consistent with the published pattern. Compound concentrations are estimated and are calculated using an internal standard response factor of 1.
PCBs, Total	Total PCBs are defined as the sum of detected Aroclors 1016, 1221, 1232, 1248, 1254, 1260, 1262, and 1268.

AIR WATER & SOIL LABORATORIES, INC.

1941 REYMET ROAD
RICHMOND, VIRGINIA 23237
(804) 358-8295 PHONE
(804)358-8297 FAX

Chain of Custody
Form #: F1331
Rev. 2.0
Effective: Jun 28, 2016

CHAIN OF CUSTODY

PAGE _____ OF _____

COMPANY NAME: HDR	INVOICE TO: HDR	PROJECT NAME/Quote #: 10055101
CONTACT: Joe Wallen	INVOICE CONTACT: Joe Wallen	SITE NAME: Four Mile Run
ADDRESS: 4470 Cox Rd, Suite 200 Glen Allen, VA 23060	INVOICE ADDRESS: same	PROJECT NUMBER: 10055101
PHONE #: 804-663-7368	INVOICE PHONE #: same	P.O. #:
FAX #:	EMAIL: joe.wallen@hdrinc.com	Pretreatment Program:
Is sample for compliance reporting? YES NO	Is sample from a chlorinated supply? YES NO	PWS I.D. #:
SAMPLER NAME (PRINT): Thomas Wallen	SAMPLER SIGNATURE: Thomas Wall	**Turn Around Time:** Circle: **10** **5 Days** **or** __ **Day(s)**

Matrix Codes: WW=Waste Water/Storm Water GW=Ground Water DW=Drinking Water S=Soil/Solids OR=Organic A=Air WP=Wipe OT=Other_____

CLIENT SAMPLE I.D.	Grab	Composite	Field Filtered (Dissolved Metals)	Composite Start Date	Composite Start Time	Grab Date or Composite Stop Date	Grab Time or Composite Stop Time	Time Preserved	Matrix (See Codes)	Number of Containers	ANALYSIS / (PRESERVATIVE) TCL 4.3 VOCs in soil (SW-846-8260C)	TAL Metals - Soils (SW-846 6010C / 7471B)	TLC 4.3 SVOCs in soil (SW-846 8270D)	Methane (RSK 175)	EPA 8082 PCBs				COMMENTS
1) 16BH-03 0-4'		X		8/21	8:45			15:00	Ice	3	X	X	X	X					1 composite
2) 16BH-03 4-10'		X		8/21	9:00				N/A	3	X	X	X	X					sample for
3) 16BH-01 0-4'		X		8/21	10:00					3	X	X	X	X					EPA 8082
4) 16BH-01 4-10'		X		8/21	10:10					3	X	X	X	X	1				PCBs - call
5) 16BH-01 10-16'		X		8/21	10:20					3	X	X	X	X					with questions
6) 16BH-02 0-6'		X		8/21	11:40					3	X	X	X	X					
7) 16BH-04 0-4'		X		8/21	12:45					3	X	X	X	X					
8) 16BH-04 4-10'		X		8/21	13:05			↓	↓	3	X	X	X	X					
9)																			NO SEAL
10)																			ON ICE

RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
Thomas J. Wall	8/21 15:30	FEDEX EXPRESS	
FEDEX			
		22 AUG 2017	10,05

QC Data Package
Level III ☐
Level IV ☐

LAB USE ONLY

COOLER TEMP 1.0 °C

HDR **17H0710**
Four Mile Run
Recd: 08/22/2017 Due: 08/29/2017

v130325002

F1331 AWS COC_v160628.xls

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Certificate of Analysis

Final Report

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Sample Conditions Checklist

Samples Received at:	**1.00°C**
How were samples received?	FedEx Express
Were Custody Seals used? If so, were they received intact?	No
Are the custody papers filled out completely and correctly?	Yes
Do all bottle labels agree with custody papers?	Yes
Is the temperature blank or representative sample within acceptable limits? (above freezing to 6°C) or received on ice and recently taken?	Yes
Are all samples within holding time for requested laboratory tests?	Yes
Is a sufficient amount of sample provided to perform the tests included?	Yes
Are all samples in appropriate containers for the analyses requested?	Yes
Were volatile organic containers received?	No
Are all volatile organic and TOX containers free of headspace?	NA
Is a trip blank provided for each VOC sample set? VOC sample sets include EPA8011, EPA504, EPA8260, EPA624, EPA8015 GRO, EPA8021, EPA524, and RSK-175.	NA
Are all samples received appropriately preserved? Note that metals containers do not require field preservation but lab preservation may delay analysis.	Yes

As per Joe Wallen via phone call:

-5 day TAT
-Samples are logged for %Solids instead of Moisture
-Approve lab composite fee for PCB analysis
-Metal, VOCs, and SVOCs are to be reported on a wet weight basis.

Samples 17H0710-01 through 17H0710-08 were composited in the laboratory to create 17H0710-09.

BAR 08/22/17 1124